ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 5.] [1907.

XXVIII.—N'HANGELLITE AND COORONGITE.

L. A. BOODLE.

A short time ago a sample of a curious substance (N'hangellite) found in Portuguese East Africa and described as elastic bitumen* was forwarded to Kew by Sir Boverton Redwood, D.Sc., M.I.M.E., who supplied the following information as to its mode of occurrence from a report made by Mr. J. Gething Hancock, M.I.M.E. :—

"N'hangellite is an elastic description of bitumen, and may be termed a mineral india-rubber. It is dark green in colour, and is lighter than water, and has probably been formed in the oxidation of petroleum. It is most prevalent in the plain to the north and north-west of Lake N'hangella, and to a large extent may be described, as far as this neighbourhood is concerned, as peculiar to that locality.

"The N'hangellite, in occurrence, is generally about half-an-inch in thickness, and lies in patches varying from a few square yards to probably half-an-acre in extent. It is chiefly found in long narrow strips on the surface-anticlines of slightly undulating ground, and gives the impression that it has been washed there by water, having largely the appearance of a high-tide mark. On the other hand, it is occasionally found in small pans, again indicating that it has been taken there by water and remained after the water had subsided. . . . I made the most searching enquiries . . . and was informed by many that after the rains it is possible to see this deposit gradually collecting, and that it is then of a light brown colour and gelatinous in appearance."

Specimens of this substance, when examined microscopically, prove to consist of a yellowish matrix, in which are embedded diatoms, sand-grains, and sometimes sponge-spicules, pollen-grains, spores, &c. ; but these inclusions are unimportant, forming

* The word "bitumen" will be used here in its extended sense.

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only a small proportion of the mass. Fungal hyphae are also present, and are often crowded and very distinct near the surface of the specimens, more sparse, and forming an irregular reticulum in the interior.

The yellowish matrix, when examined in thin sections under a high power, is usually seen to contain numerous very small cells, which are more refractive and for the most part more coloured than the substance in which they are embedded. The latter may appear colourless in very thin sections, while the cells in question are yellow, or brownish, or pale green. They are usually elongated, and their sectional shape is elliptical or pyriform, or circular when seen in end-view. In length they vary from 2 μ to 6 μ, or occasionally 8 μ, and their breadth may be about half as great or more. Frequently no definite arrangement can be distinguished, but occasionally in favourable places one can demonstrate that the cells are grouped in colonies, which appear to be roughly spherical when small, elliptical or botryoida. when large. The cells are arranged so that their length is radial with regard to the colony, in which they form a peripheral layer, one or sometimes two or more cells thick. Their lateral distance from one another is variable, but generally greater than their own diameter. When rather crowded, they are sometimes clearly arranged in pairs or groups of four. The substance in which the cells are embedded shows no structure, and might well be the product of mucilage only. It is only here and there that colonies of definite shape can be distinguished ; the scattered arrangement of the cells in other parts of the matrix may be explained as either due to flattening or distortion of colonies of similar form and size, or to the colonies having had indefinite growth, so that only young stages would show a regular form.

From such details as can be determined, there seems to be no doubt that the matrix has been derived from a gelatinous organism belonging almost certainly to the blue-green Algae, among which it would be classed under the Chroococcaceae. Prof. G. S. West, F.L.S., who kindly examined the organism for me, agrees that it certainly appears to be a blue-green Alga, and compares it with *Coelosphaerium*, Naeg., but adds that it is not exactly like anything with which he is acquainted. Its precise determination must be reserved until living material, or such as represents early stages in the formation of N'hangellite, can be obtained. Conversion into bituminous substance must imply extensive chemical changes in the mucilage, whereby the original characters of the Alga may have been altered to some extent as regards the spacing and form of the cells. Changes have no doubt also taken place in the cell-contents, hence the occasional greenish colour of the cells may be secondary and not a remnant of their original pigment. On soaking or boiling a section in water the cells undergo a curious change ; their cavities become enlarged and often appear as though empty, but, when transferred to strong glycerine, they gradually regain their original appearance.

In some parts of the specimens the matrix shows no structure, but, as the loss of structure is often not abrupt but preceded by a transitional boundary where the algal cells are collapsed or in-

distinct, it is probable that the structureless condition is secondary and due to more destructive changes than those which took place elsewhere. One may therefore assume that the whole of the matrix represents a gelatinous Alga.

The fungus consists of septate hyphae, which are usually slender, colourless, yellow, or brown, and often collapsed in the interior of the specimen, but much coarser and brownish or black near the surface, where they sometimes show distinctive characters. Mr. G. Massee, F.L.S., kindly examined some preparations in which the fungus was specially well shown, and found that it agreed closely with *Cladosporium* in its type of structure, viz., in producing microsclerotia and storage-cysts. The latter are very similar to those illustrated by him in Fig. 4 of the plate accompanying his article* on "Gummosis of *Prunus japonica*, Thunb." The fungus may have grown in the mucilage after the death of the Alga, or it may have been associated with the living Alga; in the second case the two organisms together would be described as a gelatinous lichen.

A few words may be added on the subject of the other bodies included in the matrix. Probably many different species of diatoms are present, as would be seen by collecting them from a fair-sized specimen of the substance. But it was not found possible to clean the diatoms satisfactorily either by burning or by the nitric acid and chlorate of potash method; consequently they had to be examined in thin sections of N'hangellite mounted in balsam or cresol, and this was not specially favourable for showing their more minute characters. Some preparations were submitted to Prof. G. S. West, who was able to determine the following forms:—*Epithemia gibberula*, Kuetz., *Mastogloia* sp., *Campylodiscus* sp., and *Cocconema* sp. The diatoms are scattered through the thickness of the specimens, and are in some cases fragmentary, but sometimes the frustules are intact, and may contain two greenish-brown masses apparently representing the contracted or disintegrated cell-contents. The sponge-spicules are very few and quite fragmentary. Mr. R. Kirkpatrick kindly examined one of the fragments, and found, as was to be expected, that it was impossible to identify it. The pollen-grains and spores found in one specimen were embedded close to the upper surface, and also in the interior. The fungus grew (or possibly only completed its growth) on the gelatinous Alga after it had become exposed by the subsidence of the water. This is proved by the fact that the special characters, shown by the fungal hyphae at the surface of the specimen, are also to be seen in the bounding surface of cracks, which are evidently due to drying. It is not possible to come to a satisfactory conclusion as to whether the Alga grew or collected at the bottom, or floated at the surface of the water.†

A substance of a somewhat similar appearance to N'hangellite, showing a similar mode of occurrence, and also described as an

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* *Kew Bulletin*, 1898, p. 321.

† To the kindness of Sir Boverton Redwood we are indebted for a chemical report on a sample of N'hangellite which forms the subject of the next article in the present number of the *Bulletin*.—[Ed.]

elastic bitumen, was discovered on the surface of the ground in South Australia in the neighbourhood of the Coorong (a lagoon) in 1865. It will be useful to quote some information regarding the Australian "bitumen," and to compare the two substances.

In an article written in 1872, Mr. (now Sir) W. T. Thiselton-Dyer* summed up what was known with regard to this substance, to which the following names had been given :—"Australian caoutchouc," "Coorongite," and "Mineral Gamboge." Its occurrence is thus described :—"It consists of sheet-like masses somewhat more than an inch in thickness . . . " and "is confined to a depressed portion of the district, the bottom of which is sandy and grass-covered ; it occurs on the banks forming the margins of the depression, and also on the sides of island-like elevations which are scattered about it." The precise nature of the substance appeared very doubtful, in the first place on account of the divergent views expressed by different scientific observers. M. J. Berkeley gave his opinion that there was no doubt that it was a collemal† in an imperfect state. Whittell found a mycelium and dark brown sporules (?) and several diatoms. Another observer described a granular and cellular structure with entangled fibres of decayed fungi. Archer came to the conclusion that the substance was "certainly organic,—some kind of gum with accidental things included, such as bits of vegetable tissue, some confervoid or fungal threads, and the like."

Thiselton-Dyer, in commenting on these different views and other data which he had obtained, wrote as follows :—"The suggestion which occurred to Mr. Berkeley, that it is the residue of some cryptogamic plant, is, at first sight, very plausible. One can imagine such a residue being formed by *Bromicolla aleutica*,‡ which forms in the Aleutian Isles a layer two feet thick of a Nostoc-like substance, covered with a gramineous vegetation. One can imagine it also to result from the drying up of a lake covered with *Hormonema fluitans*,§ the 'vegetable turtle fat' described by Dr. Seemann as a jelly-like mass several feet thick, with a tall species of Sedge growing on it." But after quoting an analysis‖

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* On a substance known as "Australian caoutchouc," *Journ. Bot.*, pp. 103–106.

† In a letter printed in the "Express and Telegraph" (Aug. 29, 1871) Berkeley is quoted as describing the substance as related to *Pyrenopsis tasmanica*, Naeg. This is a lichen in which the Alga is a *Glococapsa*.

‡ The general appearance of this organism was described by Eichwald (Om en ätbar Alg : *Bromicolla aleutica*, Eichw. ; Skand. Naturf. Förhandl., III., 1842, pp. 615–6), but there is no adequate description. The cells are described as scattered in a completely homogenous gelatinous substance, and the Alga is compared with *Nostoc*, on account of its gelatinous character, but stated to differ in showing no definite arrangement of the cells.

§ I have altered the spelling from *Hoomonema*, which was evidently a misprint, to *Hormonema*. Seemann, in Viti (1862), p. 28, states that Berkeley identified a sample of the "vegetable turtle fat" as *Hormospora* [sphalm. *Hoomospora*] *transversalis*, Brébisson, but re-named it *Hormonema* [sphalm. *Hoomonema*] *fluitans*. Brébisson's species is a filamentous form placed by De Toni (Sylloge Algarum) as a synonym of *Schizogonium thermale* (Menegh.), Kuetz.

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Moisture	0·4682
Carbon	64·7300
Hydrogen	11·6300
Ash	1·7900
Fixed carbon	1·0050
Oxygen and unestimated matters ...	20·3768

of Coorongite made at his request by Dr. Bernays, he points out that "any residue left by a Cryptogam (assuming of course that no extensive change of composition had taken place in it, except the loss of water)" would have a considerably different chemical composition, and for this reason inclines to regard the substance as of mineral origin, and being derived from an oily matter which originally floated on the surface of the water.

In an article on the same subject J. R. Jackson* quotes the observations of G. Francis, who concluded that Coorongite was in all probability a vegetable production, and on chemical examination found it to be "resolvable into two educts: (1) soft semi-fluid, like a balsam . . . and, except in its semi-fluidity, resembling vegetable wax"; and "(2) a tough pulverulent substance," apparently a "modified form of cellulose associated, but not chemically combined, with the first described educt."

Some further information relating to the occurrence and formation of Coorongite may be quoted from the correspondence on the subject in the years 1866 and 1867. The substance accumulates on the surface of the flood waters, which form a shallow swamp in the winter but recede annually, leaving it on the soil, so that it can be collected in summer when the ground is hard. In some places where the deposit was destroyed by fire one summer, it was again found covering the ground in the following summer. In one locality, when the deposit was removed from the surface of the ground, other layers were found buried in the sand beneath it.

In 1903 Cumming† made chemical analyses of Coorongite and gained some further knowledge of the composition of this substance. He found that, besides the ash, two constituents were present, one of them being a wax-like solid which can be extracted with carbon-disulphide; the other is insoluble in carbon-disulphide, but can be saponified by hot alcoholic solution of caustic potash, forming a soluble soap. For the soluble constituent of Coorongite he obtains the formula $(C_{10}H_{18}O)_x$, with x probably equalling 8, and for the other constituent $C_{10}H_{20}O_3$, the figures given by the analyses being as follows:—

	Soluble Constituent.	Insoluble Constituent.
Carbon	... 77·91	... ... 64·22
Hydrogen ...	... 11·92	... ... 10·52
Oxygen ...	... 10·17	... ... 25·26

Cumming suggests that the insoluble constituent may have been derived from the soluble one by hydration and oxidation.

On examining samples of Coorongite in the Museum at Kew, I found that this substance bears a distinct resemblance to N'hangellite. There is a yellowish matrix which, though much more generally structureless than in the other case, shows an Alga

* J. R. Jackson, Coorongite or Mineral Caoutchouc of South Australia (Pharm. Journ. and Trans., 1872, pp. 763-4 and 785).

† Cumming, Coorongite, a South Australian Elaterite, "Chemical News," vol. 87 (1903), p. 306.

of the same type here and there; diatoms are present and are decidedly more numerous, and there is a fungus, which again is more distinct near the surface of the specimens; fragments of parenchymatous tissue are also present. I submitted a slide to Prof. G. S. West, who notes that the Alga is very similar to that in N'hangellite, and certainly belongs to the same genus, but differs in its larger and more crowded cells. Besides the diatoms he observed other aquatic organisms, viz., *Peridinium* sp., and some Desmids (*Cosmarium* 2 spp., *Xanthidium* 1 sp.). A list of diatoms present in Coorongite was made by E. O'Meara in 1872. The species were named by him as follows:—*Denticula tenuis*, *Cymbella helvetica*, *C. maculata*, *Tabellaria flocculosa*, *Mastogloia Smithii*, *Synedra capitata*, *Epithemia gibba*, *E. rupestris*, *Nitzschia palea*, *Amphora minutissima*, *Navicula rhomboides*, *N. gibberula*. He also pointed out that they were all fresh-water forms, and Prof. West mentions that the same is true of the *Cocconema* sp. and *Epithemia gibberula* found in N'hangellite. One may, I think, safely assume that Coorongite had a similar origin to N'hangellite, but, since the Alga is only visible here and there, the evidence for the origin of the matrix is not so strong. It may perhaps include additional components, but on the other hand it is quite likely that the bulk of it is the product of the gelatinous Alga (or Algae). Thus one observation gives passable evidence that parts at any rate of the structureless regions of the matrix are of this nature. A few small colonies, bounded by brownish outlines and containing their Algal cells, were seen embedded in a matrix in which there was no structure beyond brownish outlines of the same size and shape as those of the adjacent colonies referred to.

Taking it as established that the greater part of the substance in N'hangellite has been derived from a gelatinous Alga, there remains the problem as to how the mucilage has become transformed into a material showing the characters of bitumen, and whether the change took place under water or on dry ground. In neither of these positions does it appear likely that a gelatinous mass should have become uniformly infiltrated by bitumen or petroleum, so one must assume that chemical changes have taken place in the mucilaginous substance itself. The nature and cause of these changes may ultimately be determined by chemical investigation combined with observations in the locality where N'hangellite is said to be seen in process of formation. If this substance is formed every year, as appears to have been observed in the case of Coorongite, it is very surprising that extensive chemical changes should take place in such a short space of time and under such apparently ordinary conditions. Assuming the original gelatinous substance to consist largely of muco-cellulose, a considerable loss of oxygen must take place. Without any clue to other agents, one can only suggest the possibility of an enzyme being concerned.

N'hangellite is extremely interesting as being apparently comparable to certain fossil deposits, viz., examples of kerosene shale and boghead coal, &c., in which gelatinous Algae sometimes formed the chief part of the deposit. These Algae, which are occasionally well-preserved, were examined by Bertrand and

Renault,* who gave names to the different forms. One of these, *Pila australis*, Bertr., was a gelatinous Alga forming colonies, in which the cells were peripheral. It was probably one of the Cyanophyceae, and differed from the Alga in N'hangellite in several particulars, though the arrangement of the cells in the colonies was similar to that in the small colonies seen in N'hangellite. In those deposits which were formed chiefly from gelatinous Algae, Bertrand regards the substance derived from the mucilage as having become infiltrated by bitumen. In other cases where the Algae are less abundant he attributes a great part of the substance to the deposition of humic compounds in gelatinous form from the water in which the Algae grew.

The conclusion to be drawn from the examination of N'hangellite is that the substance has been derived, chiefly at any rate, from masses of a gelatinous Alga, and that chemical changes must have taken place in the mucilage, giving it a bituminous character. Whether humic acid may have contributed in some degree to the formation of the substance remains to be proved, but that extraneous petroleum should have done so is entirely improbable. Hence the occurrence of N'hangellite gives no evidence for the presence of petroleum in the district in which it is found, but in a permanent lake-region similar deposits may well have been formed from time to time, giving rise ultimately to fossil deposits of bitumen or strata containing petroleum.

XXIX.—REPORT ON A SAMPLE OF N'HANGELLITE FROM INHAMBANE, PORTUGUESE EAST AFRICA.

Sir Boverton Redwood.

The greater part of the sample consisted of fragments of various sizes about half-an-inch in thickness, the remainder consisting of pieces about one-eighth of an inch thick. Both were elastic. The thinner pieces were translucent and of a brown colour by transmitted light. The thicker pieces on being cut through appeared to be fairly uniform throughout, but the weathered surfaces seemed to be less elastic than the interior. The thinner pieces showed signs of lamination and could be split into layers.

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* Bertrand et Renault, *Pila bibractensis* et le boghead d'Autun, *Bull. Soc. d'Hist. Nat. d'Autun*, 1892; Bertrand, Le Kerosene Shale de la Nouvelle-Galles du Sud, *ibid.* 1896; Renault, Les Organismes des Cannels, *Bull. Muséum d'Hist. Nat.*, Paris, 1898; Bertrand, Kerosene Shale de Megalong Valley, *Ann. Soc. Géol. du Nord*, Lille, 1900; Bertrand, Charbons gélosiques et charbons humiques, *Compte-rendu du VIII. Congrès géologique internat.* 1900, Paris, 1901; and other papers.

Portions of the sample furnished the following results :—

——	Thick.	Thin.
	Per cent.	Per cent.
Moisture	1·1	2·4
Other volatile matter	89·5	86·6
Fixed carbon	5·2	3·8
Ash	4·2	7·2
	100·0	100·0

Dried Sample.

Ash ... ... 5·94 per cent.
Sulphur ... ... 0·06 „

Chemical composition, calculated on the ash-free substance :—

Carbon ... ... 69·63 per cent.
Hydrogen ... ... 10·35 „
Nitrogen ... ... 2·50 „
Oxygen (by difference) ... 17·52 „
100·00 „

Yield on destructive distillation :—

——	1.	2.	Average.
	Per cent.	Per cent.	Per cent.
Oil distillate	56·9	46·2	49·6
Aqueous distillate	9·0	9·5	9·3
Coke	18·3	22·7	21·4
Loss (incondensable gas)	15·8	21·6	19·7
	100·0	100·0	100·0

The oil had a specific gravity of 0·857 and a flash-point of 75° F. (close test). It resembled the mineral oil obtained by the destructive distillation of bituminous substances and could doubtless be separated by fractional distillation into similar hydrocarbon commercial products. It yielded 3·8 per cent. of solid hydrocarbons (paraffin) with a melting-point of 120° F.

Soluble in benzene (C_6H_6) :—

Thick ... ... 12·0 per cent.
Thin ... ... 10·5 „

The extracted matter had a balsamic odour.

The N'hangellite exhibited considerable charring on being heated with strong sulphuric acid; and on being heated with strong nitric acid it passed into solution, but a precipitate was thrown down on cooling.

XXX.—AMERICAN RUBBER PLANTS.

W. B. Hemsley.

In 1898 a beginning was made in *Hooker's Icones Plantarum* with the publication of figures and descriptions of American Rubber Plants, partly of authenticated specimens of more or less known species, partly of species believed to be previously undescribed. Any notes by collectors respecting the quality of the rubber yielded by the species under consideration were reproduced. The genera *Hevea*, *Sapium*, and *Castilloa* have been partially illustrated, and it is intended to continue the series from time to time as circumstances permit. More rapid progress has been prevented by other work. The genus *Sapium*, especially, was in a chaotic condition, due in a great measure to the fact that botanists had followed each other in placing a large number of quite distinct species as varieties of *Sapium biglandulosum*. About a dozen such species have already been figured in the *Icones Plantarum*, and drawings of the dissections of the flowers of many others have already been made in continuation of the revision. Meanwhile, Dr. J. Huber, of Para, Brazil, has taken up the study of both *Hevea* and *Sapium*, much on the same lines, and his work is mostly in sympathetic accord with what has appeared in the *Icones Plantarum*, and our future illustrations will usefully supplement his excellent synopses. Dr. Huber's "Ensaio d'uma Synopse das Especies do Genero *Hevea* sob os pontos de vista Systematico e Geographico" appeared in the *Boletim do Museu Goeldi* for March, 1906, pp. 620 to 651, without illustration of any kind. The same author's revision of the species of *Sapium* was published in the *Bulletin de l'Herbier Boissier*, 1906, vol. vi., pp. 345 to 364 and 433 to 452, with numerous small but critical figures in the text, under the title: "Revue critique des Espèces du Genre Sapium." When the Kew collection of *Sapium* has been critically elaborated in connection with Huber's "Revue," we shall have some observations to make on the points of agreement and otherwise.

Dr. Huber classifies the species of *Hevea* as follows:—

Section 1. Euhevea, Muell. Arg. Anthers in one whorl of 5.

1. *guayanensis*, Aubl.
2. *nigra*, Ule.

Section 2. Bisiphonia, Muell. Arg. Anthers in two whorls.

Series **Luteae**. Anthers in two incomplete whorls. Inflorescence yellowish or gray. Buds of the male flowers acuminate.

1. Disk of the male flower rudimentary.
   3. *lutea*, Muell. Arg.
   4. *apiculata*, Muell. Arg.
   5. *cuneata*, Huber.

2. Disk of the male flower stellate.
   6. *Benthamiana*, Muell. Arg.
   7. *Duckei*, Huber.
   8. *paludosa*, Ule.

3. Disk of the male flower with elongated segments.
   9. *rigidifolia*, Muell. Arg.

Series **Intermediae.** Anthers in two complete series. Inflorescence pale yellow or white. Buds of the male flowers acuminate.

1. Style well-developed...
   10. *minor*, Hemsl.
   11. *microphylla*, Ule.

2. Style obsolete ... ...
   12. *Randiana*, Huber.
   13. *brasiliensis*, Muell. Arg.

Series **Obtusiflorae.** Anthers in two complete series. Inflorescence whitish or more or less violet. Buds of the male flowers obtuse.

1. Disk of the male flower composed of 5 obtuse glands.
   14. *Spruceana*, Muell. Arg.
   15. *similis*, Hemsl.
   16. *discolor*, Muell. Arg.

2. Disk of the male flower composed of acuminate glands.
   17. *pauciflora*, Muell. Arg.
   18. *confusa*, Hemsl.

Of uncertain position ...
   19. *nitida*, Muell. Arg.
   20. *viridis*, Huber.
   21. *Kunthiana*, Huber.

It is not intended to criticise the foregoing classification, nor to question the limitation of the species, as both are doubtless the result of a much more extended study of the genus than the writer can lay claim to; but it may be mentioned that *Hevea cuneata*, Huber, is the same as, or at least intended by the author to include, *H. peruviana*, Lechler. In *Hooker's Icones Plantarum*, t. 2574, the latter and *H. apiculata*, Baillon, are regarded as synonymous with *H. lutea*, Mueller.

It may be useful to add here a list of the American Rubber Plants already figured and described in the *Icones Plantarum*.

I.—Hevea.

H. apiculata, Baill., vol. xxvi., t. 2574, f. 11–14. Male and female flowers.

H. Benthamiana, Muell. Arg., vol. xxvi., t. 2571 and t. 2575, f. 16 and 17. Seeds.

H. brasiliensis, Muell. Arg., vol. xxvi., t. 2573, f. 1–7. Analysis of male and female flowers. t. 2575, f. 1–7. Germinating seeds.

H. confusa, Hemsl., vol. xxvi., t. 2570 and t. 2574, f. 1–3. Male and female flowers. t. 2575, f. 12 and 13. Seeds.

H. discolor, Muell. Arg., vol. xxvi., t. 2573, f. 18–21. Male and female flowers. t. 2575, f. 8–11. Seeds.

H. guianensis, Aubl., vol. xxvi., t. 2573, f. 8–10. Male and female flowers.

H. janeirensis, Muell. Arg., vol. xxvi., t. 2573, f. 1 and 2. Male and female flowers.

H. lutea, Muell. Arg., vol. xxvi., t. 2574, f. 11–14. Male and female flowers.

H. membranacea, Muell. Arg. = *H. pauciflora*, Muell. Arg.

H. minor, Hemsl., vol. xxvi., t. 2572.

H. pauciflora, Muell. Arg., vol. xxvi., t. 2574, f. 4–7. Male and female flowers. t. 2575, f. 14 and 15. Seeds.

H. peruviana, Aubl. = *H. guianensis*, Aubl.

H. peruviana, Lechler, vol. xxvi., t. 2574, f. 19–21. Male and female flowers.

H. rigidifolia, Muell. Arg., vol. xxvi., t. 2573, f. 11–13. Male and female flowers.

H. similis, Hemsl., vol. xxvi., t. 2576.

H. Spruceana, Muell. Arg., vol. xxvi., t. 2570 and t. 2573, f. 14–17. Male and female flowers.

Where no explanation is given, the whole plate is devoted to the species in question with a representation of the foliage and inflorescence, natural size, and usually with analysis of the flowers, enlarged.

II.—Sapium.

S. aereum, Kl., vol. xxvii., t. 2682.

S. aucuparium, Jacq., vol. xxvii., t. 2650.

S. ciliatum, Hemsl., vol. xxvii., t. 2683.

S. cupuliferum, Hemsl., vol. xxvii., t. 2679.

S. Jenmani, Hemsl., vol. xxvii., t. 2649.

S. lateriflorum, Hemsl., vol. xxvii., t. 2680.

S. mexicanum, Hemsl., vol. xxvii., t. 2680.

S. Moritzianum, Kl., vol. xxvii., t. 2677.

S. paucinervium, Hemsl., vol. xxvii., t. 2648.

S. Poeppigii, Hemsl., vol. xxvii., t. 2678.

S. stylare, Muell. Arg., vol. xxviii., t. 2757.

S. suberosum, Muell. Arg., vol. xxvii., t. 2681.

S. subsessile, Hemsl., vol. xxvii., t. 2684.

S. verum, Hemsl., vol. xxvii., t. 2647.

Dr. Huber does not agree with our view of *S. aucuparium*, Jacq., and he may be right; but we shall return to this question again after our final revision of the Kew materials. It is the *S. Hemsleyanum* of Huber (*Bull. de l'Herb. Boiss.*, 1906, vol. vi., p. 361, f. 22), who further identifies *S. mexicanum*, Hemsl., with the type of *S. macrocarpum*, Muell. Arg.

III.—Castilloa.

C. australis, Hemsl., vol. xxvii., t. 2676.

C. Tunu, Hemsl., vol. xxvii., t. 2651.

Under tab. 2651 we have reduced *Castilloa Markhamiana* to *C. elastica*, and given reasons for the opinion that *C. costaricana*, Liebm., belongs to the same species.

XXXI.—ADDITIONS TO THE WILD FAUNA AND FLORA OF THE ROYAL BOTANIC GARDENS, KEW: III.

LEPIDOPTERA.

A. Langley Simmons.

The season of 1906 was not a good one for the collection of insects belonging to this order. The prevalence of cold winds in the early summer retarded both insect and vegetable life generally, and particularly in the South of England the absence of butterflies was most marked. With the exception of parts of the Dorset and Kent coasts it is many years since they were so scarce. Near London this scarcity will no doubt be more noticeable every year, especially of the butterflies belonging to the genus *Vanessa*, the larvae of which feed principally on the nettle. As the suburbs grow so will the wild food plants disappear, with the consequent diminution of insect and other life. In the Gardens the absence of the *Rhopalocera* was also observed, the most plentiful species being the second broods of *Vanessa urticae*. Very few *V. atalanta* or *V. io* were seen and only one *V. cardui*. Of the *Lycaenidae*, *Cyaniris argiolus* was strangely very much more plentiful than *C. icarus*, while not a single species of the *Hesperiidae* was observed during the whole of the season. *Apatura iris* was carefully watched for in the Queen's Cottage grounds, but it does not seem now to obtain there, although it has been taken recently in Richmond Park. Queen's Cottage grounds with its glorious oaks and necessary *Salix Caprea* for the food plant would seem to provide an ideal reserve for the propagation of "his majesty." While lying under the trees on the hottest afternoons watching the tops of the massive oaks, standing out in all their midsummer glory against the blue sky, it seemed that it just wanted the iridescent flash from the wings of the "emperor" soaring up into the sunlight to complete an otherwise perfectly lovely scene. All true lovers of nature would be sincerely pleased to know that this magnificent insect could be seen amid such surroundings, and although not observed this season one may yet hope that it will make an appearance in this part of the gardens.

Not any additions were made to the list of butterflies already published, nor were any exotic specimens seen.

Probably no small area of ground has ever been so thoroughly and systematically worked for the lepidopterous fauna in all stages of its existence as the gardens were during the late spring, summer and autumn of 1906. The list of the species obtained appearing at the end of these notes together with the list which appeared in the *Kew Bulletin*, Additional Series V., speaks for itself as to the richness of the gardens in the order under notice. One ought not, perhaps, to be surprised at the results obtained when it is remembered that the two essentials for the natural propagation of insect life, namely variety and profusion of the necessary food plants, here prevail and there is an area, principally in the Queen's Cottage grounds, in which the surface of the ground and plants are absolutely undisturbed. Remembering even these fortunate circumstances, the fact remains that the gardens are within eight miles of the metropolis, a distance which does not prevent the soot and dirt of a great city under favourable conditions settling on and darkening the plant life. This has caused in many cases pronounced forms of melanism. It is interesting to compare these melanic variations, when they occur with normal types, the darkening process being quite as apparent in the micro-lepidoptera as in the larger species.

The gardens appear to be, fortunately, very free, with one exception, from those species of lepidopterous larvae which at times cause such devastation to plant life in country districts and on the continent. It may be remembered that this year saw a wonderful visitation of *Orgyia antiqua* in the London parks. In Hyde Park during July and August the trees were in numbers of cases defoliated by the ravages of the handsome little caterpillar. They covered the ground, trees, seats and palings in countless thousands, and the idea that the plane trees were immune from these attacks was completely upset—these were the trees that suffered the most. Only two males were seen in the gardens, and not one of the apterous females has been collected. The larvae of *Pygera bucephala* appeared to be rather abundant, and large clusters were seen hanging on the lime trees. The imagos will probably be very plentiful during the summer of 1907. This species also at times causes much damage to *Carpinus Betulus*, *Corylus Avellana* and *Ulmus campestris*. The cobweb like structures made by the larvae of *Yponomeuta euonymellus* were seen thickly covering bushes of a variegated form of *Euonymus europaeus*, a plant not usually selected by this caterpillar for its food, *Prunus Padus* generally affording the required sustenance. Where the bushes had been attacked they had been stripped clean of leaves. *Tyria jacobaea* was plentiful in all parts of England during the early summer, but only one moth was caught in the gardens. Later in the season, however, a quantity of larvae were discovered feeding on *Senecio alpinus* in the Herbaceous grounds; this plant is very different in aspect from *S. Jacobaea* and *S. vulgaris*, its ordinary food plants. In Devonshire it is known to feed at times on the potato, quite clearing the stalks of leaves.

The usual "baits" were employed for the enticing and snaring of moths. Sugaring was commenced in April and continued till the end of October, but, until the 8th of August, met with but scant success. This may be accounted for perhaps by the fact that

during the greater part of the summer there were countless flowering plants in the gardens giving off strong scents which would prove more attractive to the moths than black treacle and rum. When the ivy is in blossom in the autumn, this usually successful mixture is a failure. But it was interesting to notice that as soon as most of the heavily scented flowering plants had ceased blooming the sugar bait became effective. The only insects which were unable to resist the subtle effluvia thrown off by the treacle before August were a few *Dipterygia pinastri*, *Agrotis corticea*, *Agrotis pronuba*, *Hadena polyodon*, *Agrotis exclamationis*, *Euplexia lucipara* and *Rusina tenebrosa*, caught in the order named. Some of these became old friends. Night after night the same individuals were to be observed imbibing on the same tree until in the course of time fate overtook them ; they paid the penalty of over indulgence and the patch of treacle knew them no more. Two toads evidently understood the connection between treacle, moths, and the satisfying of their appetites. They had placed themselves at the base of an elm tree and awaited patiently for what the gods sent them in the shape of inebriated moths. One toad had emulated the tree-climbing propensities of its cousin the climber and by dint of great exertion managed to climb three feet up the trunk of the tree to get at its prey.

A remarkably interesting flashlight photograph of moths at treacle was taken in September by Mr. W. J. Holman and is reproduced on the opposite page. There are seven moths, all of the same species (*Noctua xanthographa*), shewn feeding on the treacle placed on the trunk of a large oak tree. At the moment the magnesium was flashed there were over fifty of these moths and of *Cosmia diffinis* on the tree. Great efforts were made to induce a very large *Catocala nupta*, which was on the treacle at the time, to come into the field of operations, but in spite of all blandishments and gentle tickling the red underwing could not be persuaded, and finally shewed his objection to this treatment by soaring into the shades of the night. The photograph shews how well the moths approximate in colour and conformation to their surroundings. A few minutes after the flash the moths had returned to the treacle and were feeding as busily as before.

A specially constructed light trap was also used on all favourable nights in the summer, but this met with scarcely any success. It was usually placed in the open glades in the Queen's Cottage grounds. On one occasion it was put by the side of the lake under an oak tree, and in the morning considerably over a hundred *Crambus geniculeus* were found inside. This was the only night that it caught any number of moths. A strong light was on many occasions hung from the trees at an altitude of about twenty feet—this also was not a success.

Mr. R. South, F.E.S., who compiled the first list of Lepidoptera which appeared in the *Kew Bulletin*, Additional Series, V., issued last year, very kindly went through the list of species captured, along with the insects, and checked the naming. The writer wishes to record the assistance he has received in obtaining the most recent facts and records from the late Mr. C. Barrett's magnificent work "The Lepidoptera of the British Isles," and from Meyrick's

Photo by W. G. Holman, Kew

Flashlight photograph of moths (*Noctua xanthographa*) at treacle, on an oak tree. Taken at 10.30 p.m., September 1st, 1906.

"Handbook of British Lepidoptera" for information respecting the Microlepidoptera. Mr. Alfred Sich, F.E.S., has also kindly lent his valuable assistance, and with his aid the list will no doubt in time be greatly extended. A word of thanks must be paid to Mr. G. Nicholson, F.L.S., for his indefatigable efforts in collecting. Without his work the list would not have assumed the proportions it has. The officials in the Gardens have also been most obliging in retaining any specimen which they thought might be interesting; their co-operation in the good work is of the greatest importance.

HETEROCERA.

NOTODONTINA.

SPHINGIDAE.

Deilephila elpenor, *L.* "The Large Elephant Hawk-moth."

Larva of this species taken full fed. Also many pupae found under various trees. A fairly common hawk-moth generally distributed over the British Isles and belonging to a genus which is large and nearly cosmopolitan. Larvae feed on *Galium*, *Epilobium*, *Fuchsia*, &c.

Macroglossa stellatarum, *L.* "The Humming-bird Hawk-moth."

A dead specimen was found by Mr. G. Nicholson inside Q.C. A common insect much more plentiful some years than others. The only representative in Britain, where it occurs generally, of a large genus found all over the world. A day flyer, feeding on the wing. Larva feeds on *Galium*.

(A large number of hawk-moths were seen flying during the summer months, but their flight was, of course, too rapid to enable them to be identified. Their favorite haunts were about the large clumps of rhododendron. The larvae of *Smerinthus populi*, *S. ocellatus* and *Dilina tiliae* were found to be plentiful.)

NOTODONTIDAE.

Notodonta camelina, *L.* "The Coxcomb Prominent."

Generally common throughout British Isles; also N. & C. Europe, N. Asia. On oak, beech, hazel, &c.

Tyria jacobaeae, *L.* "The Cinnabar Moth."

Common to British Isles except N. Scotland; Europe generally and W. C. Asia. On *Senecio Jacobaea*, *S. vulgaris*, and *S. alpinus*.

CARADRININA.

LIPARIDAE.

Orgyia. A genus of some extent and general distribution in the northern hemisphere. The moths fly freely in the sunshine.

Orgyia antiqua, *L.* "The Common Vapourer."

Males only seen. The female, which has only rudimentary wings was fortunately not observed. It occurs generally throughout the British Isles, also Europe, Asia Minor, N. Africa, N. America. On rose, hawthorn, hazel and many other plants. It has during the last two or three years been a pest in the London parks, defoliating the plane trees.

TRIFIDAE.

NOCTUIDAE.

This family is very extensive, in fact a dominant one in the temperate regions of the northern hemisphere. In the phylogeny of lepidoptera it takes an extremely high position, melanism also occurring more frequently in species belonging to this family than in any other. There are more than three hundred moths represented in the Noctuidae in Britain alone, and considerably over two thousand in the various portions of the globe.

Acronycta aceris, *L.* "The Sycamore."

Not so common as others of the same genus. To be found resting on the trunks of sycamore and other trees. Generally distributed in England, also Europe and Asia Minor. Larva feeds on sycamore, oak, horse-chestnut, maple and birch.

Acronycta rumicis, *L.* "The Knot Grass."

Common to the British Isles, Europe, C. Asia, N. Africa. Appears in the early summer, the very dark specimens formerly known as var. *A. Salicis* preponderating. On *Polygonum*, *Salix*, *Veronica*, &c.

Leucania, *O.* An extremely large genus common everywhere, especially in New Zealand, and often difficult of identification as between the various species. The larvae all feed on *Gramineae.*

Leucania lithargyrea, *Esp.* "The Clay."

Common all over Britain. On grasses.

Agrotis, *O.* Another very large genus occurring all over the world especially plentiful in the northern hemisphere. The larvae are very indiscriminate in their tastes, often feeding on almost any low plant; they are frequently subterranean in habit and usually emerge by night to feed. Included in this genus are many species which are at times most destructive to vegetation, but happily not of frequent occurrence in the garden.

Agrotis segetum, *Schiff.*

One extremely dark specimen, the imago emerging in January! The larva was taken by W. Dallimore in his garden at the Lion Gate. This is the caterpillar which in some years attacks in its thousands the young turnips, mangold wurzel, carrots, cabbages and most root crops. Dressings of gas lime appear to diminish their number, and it is a caterpillar of which the rooks are very fond. The farmer has cause to bless the rook for his partiality for this particular form of diet.

Agrotis saucia, *Hb.* "The Pearly Underwing."

Taken by Mrs. Hemsley at light. Generally distributed in Britain and N. hemisphere. Some years, for unknown reasons, very scarce. On *Rumex*, *Trifolium*, *Stellaria*.

Agrotis corticea, *Hüb.* "The Heart and Club."

This species appeared in the previous list, and is only mentioned again to record the marked melanic forms captured. While an extremely variable insect, those captured were abnormally dark, in many cases the reniform and orbicular markings being absent.

Agrotis puta, *Hüb.* "The Shuttle-shaped Dart."

A moth fairly well distributed over the South of England but becoming rarer. At one time common near London, but now much scarcer. Also S. Europe and N. Africa. Dark specimens taken in nearly every case, males and females being scarcely distinguishable. On *Polygonum*, *Taraxacum*, *Lactuca*.

Triphaena subsequa, *Hüb.* (*T. orbona*, Hb.) "The Lunar Yellow Underwing."

This rarest insect of the genus was seen at sugar, but a too eager effort failed to box the prize. It is a pleasure, however, to be able to record its occurrence. Very local in Britain, but commoner in other parts of Europe. On grasses, *Primula*, *Ranunculus*, *Stellaria*, *Phalaris*, &c.

Triphaena janthina, *Esp.* "The Lesser Broad-border Yellow Underwing."

Abundant in the gardens, especially Q. C., general in the southern and midland counties; also S. Europe and Asia Minor. On *Arum*, *Atriplex*, *Primula*, *Stellaria*, and low plants.

Triphaena interjecta, *Hüb.* "The Least Yellow Underwing."

The smallest member of the genus. Fairly common in south of England; scarcer towards the north. West Europe only. On *Primula*, *Salix*, *Rumex*.

Noctua triangulum, *Hufn.* "The Double Square Spot."

Taken freely in most English counties, Europe, and N. America. In the autumn the larva feeds on dock, chickweed, wood spurge; in the spring the same and bramble, sloe, hawthorn, sallow, &c.

Noctua rubi, *View.* "The Small Square Spot."

A double-brooded species, the moth appearing in May and August. Very plentiful in Q.C. Common in Britain, Europe, and N. America. On low-growing plants generally.

Noctua neglecta, *Hüb.* (*castanea*, Staud.). "The Gray Rustic."

Widely distributed but not common. Scarce in Surrey. The one specimen taken was captured by W. G. Holman and was of the rich red recurrent form. Generally found on heaths. Also W. Europe and Italy. On *Calluna*, &c.

Charoeas graminis, *Liv.* "The Antler."

The only representative of the genus in Britain. Common and widely distributed over the northern hemisphere. At times appearing in amazing profusion. In 1881 Lancashire and Yorkshire were visited by countless thousands, and Wales in 1884, the caterpillars devastating the land over which they passed. Visitations of this lepidopterous pest are most destructive to grass lands, and the damage caused on the Continent is sometimes severe. The winter is passed in the egg state ; the larva is principally a grass feeder on the harder aud smoother species.

Xylophasia hepatica, *Hüb.* "The Clouded Brindle."

Common to English counties, C. Europe, and N. Asia. A grass feeder.

Hadena, *Schrk.* A genus of considerable extent distributed over both hemispheres but not touching New Zealand.

Hadena chenopodii, *Fab.* (*trifolii*, Staud.). "The Nutmeg."

Rather a local species, but apparently abundant at Kew. Generally found in waste places and on the coast where *Chenopodium* is plentiful. Commoner in Scotland than England, but not Ireland. Cosmopolitan. The moth feeds at *Knautia arvensis* or *Centaurea* in the daytime, and the larva on *Chenopodium album*, *C. Vulvaria*, *C. Bonus—Henricus*, *C. botryoides*, and *Atriplex patula*. Double-brooded.

Dianthoecia cucubali, *Fuesl.* "The Campion."

Found throughout the British Isles and right across Europe and Asia to Japan. Double-brooded. In seed capsules of *Silene* and *Lychnis*.

Dianthoecia capsincola, *Hüb.* "The Lychnis."

Common over the British Isles and generally distributed throughout the northern hemisphere, especially in mountainous regions. On seeds of *Silene*, *Lychnis*, and *Dianthus*. Double-brooded.

Cerige cytherea, *Fab.* (*matura*, Hufn.). "The Straw Underwing."

The only representative of the genus. Plentiful in Q.C., and all taken being extremely dark. A common European moth. On grasses—*Poa*, *Nardus*, &c.

Apamea basilinea, *Fab.* "The Rustic Shoulder-knot."

A very common moth all over the United Kingdom and the temperate regions of the globe. On wheat grains, grasses, *Taraxacum*, &c.

Apamea ophiogramma, *Esp.* "The Double-lobed."

A local species, found only in England and a few localities in Ireland. Some years ago it was plentiful in the suburbs of London, but is now much scarcer. Several specimens were taken near the lake. It has a wide habitat in Europe and C. Asia, but is nowhere common. The larva feeds in the autumn on *Phalaris*

arundinacea, living in the central stem and eating out the young growing shoot. It hybernates in the ground in the winter, feeding again in the spring on the same food plant.

Apamea unanimis, *Tr.* "The Small Clouded Brindle."

A rather scarce insect and uncertain in its appearance. Found locally in the southern and northern counties and fen districts; C. Europe to the Urals. On *Phalaris arundinacea*, *Triticum repens*, *Deschampsia flexuosa*, and other grasses. Those taken were abnormally dark, the marbling being just apparent.

Miana strigilis, *Cl.* "The Marbled Minor."

A species subject to great variety in marking. Melanism most marked in all the specimens taken, some being quite black without shewing any appearance of the marbling. The black variety (*aethiops*) seems to be the typical form in the Gardens. Common throughout Britain, Europe, Asia Minor, and Vancouver Island. On grasses.

Miana literosa, *Haw.* "The Rosy Minor."

Local, but widely distributed in Britain, Europe, and C. Asia. In the stems of *Carex glauca*, *Dactylis glomerata*, *Iris foetidissima*, *Elymus arenarius*.

Miana furuncula, *Hüb.* "The Cloaked Minor."

Common all over Britain, Europe, and Asia Minor and N.-W. Asia. The var. *bicoloria*, Vill., was also taken. In the stem of *Festuca arundinacea*, *Deschampsia caespitosa*, *Arrhenatherum avenaceum*, and coarse grasses generally.

Miana fasciuncula, *Haw.* "The Middle Barred Minor."

Common to Britain, C. and S. Europe. On the leaves and stems of grasses.

Mania maura, *L.* "The Old Lady."

The only representative of the genus. A large sombre-coloured species with a peculiar flapping flight. Common to Britain and C. Europe. On *Salix*, *Rubus*, *Primula*, dock, lettuce, cabbage, and other low-growing plants.

Amphipyra tragopogonis, *L.* "The Mouse."

Common to Britain and northern hemisphere. On *Plantago*, *Aquilegia*, *Artemisia*, *Serratula* and herbaceous plants generally.

Amphipyra pyramidea, *L.* "The Copper Underwing."

Fairly distributed in woods in the southern and midland counties of England; extensive range over Europe and Asia. Very plentiful in Q.C. On oak, sallow, poplar, birch, elm, plum, rose and other shrubs.

Caradrina, *O.* A large genus of almost universal distribution, but absent from New Zealand.

Caradrina morpheus, *Hafn.* "The Mottled Rustic."

Common in England, C. and N. Europe. Those taken were all extremely dark. On *Sedum*, *Salix*, *Rubus*, etc.

Caradrina ambigua, *Fab.*

A recently introduced species and extremely rare. It has at intervals been taken in the Isle of Wight, Kent, Dorset, Devon, and Cornwall. From having been captured in the gardens its habitat would appear to be spreading. It is found also in C. and S. Europe and Spain. Barrett gives the food plants as lettuce, chickweed, dandelion, plantain and other low-growing plants.

Caradrina alsines, *Brh.* "The Uncertain."

Common to British Isles, N. and C. Europe, Asia Minor and N. Asia. On *Stellaria, Rumex, Viola.*

Calymnia affinis, *L.* "The Lesser Spotted Pinion."

Fairly common in England as far as the Humber, C. Europe and Japan. On *Ulmus campestris.*

Orthosia, *O.* A large genus found all over the world, the imagines generally appearing in the autumn, their coloring being well adapted for hiding among the falling leaves.

Orthosia ferruginea, *Schiff* (*circellaris*, Staud.). "The Brick."

Common throughout United Kingdom, Europe and N. America. On seeds and buds of wych elm, poplar, ash, and *Salix.*

Orthosia pistacina, *Schiff.* "The Beaded Chestnut."

An extremely variable species, imagines of all shades were captured, especially the extremely dark variety. Abundant in England and Ireland, scarce in Scotland ; also S. Europe and Asia Minor. On *Carex, Ranunculus bulbosus, R. acris, R. repens* and chickweed, clover and other low-growing plants.

Orthosia lota, *Cl.* "The Red Line Quaker."

Distributed throughout British Isles, Europe and Asia. On *Salix fragilis.*

Orthosia lunosa, *Haw.* "The Lunar Underwing."

Common in England and Ireland, scarcer in Scotland ; also France and Spain only. On *Poa annua* and other grasses.

Xanthia cerago, *Schiff* (*fulvago*, Staud.). "The Lemon Sallow."

Generally distributed through British Isles, with a wide range throughout Europe, Tartary, and the mountainous districts of C. Asia. Larva when young feeds inside the catkins of *Salix Caprea*, later upon the leaves.

Cerastis spadicea, *Esp.* "The Dark Chestnut."

Common to England only and C. Europe. On *Lonicera* and hawthorn.

Xylocampa lithoriza, *Bark.* (*Areola*, Staud.) "The Early Grey."

One of the earliest moths of the year, being on the wing in March. Not one of the commonest species. Generally distributed throughout British Isles, W. Europe and Asia Minor. Imago feeds on the wing at the sallow blooms ; larva on *Lonicera.*

Plusia moneta, *Fab.* "The Golden Ear Moth."

A recent importation to England, it having been unobserved before 1890. It is a singularly handsome moth, the markings being delicate and metallic. One specimen was taken on the wing at the Lion Gate by W. Dallimore. It seems confined to gardens, and has been taken as far north as Leicester and Norfolk, and from recorded captures seems to be establishing itself in this country. It has also a wide range in C. Europe and N. Asia. The larva feeds on *Aconitum Napellus*, *A. Lycoctonum*, and various species of *Delphinium* and *Trollius europaeus*, feeding on the blossom as well as the leaves.

Habrostola triplasia, *L.* "The Dark Spectacles."

Fairly common throughout British Isles, being especially abundant in Ireland. Also Europe, W. C. Asia, N. Persia and N. Africa. On Nettle, *Humulus* and *Lamium*.

Gonoptera libatrix, *L.* "The Herald."

Common to Britain and Ireland, also Europe, Asia to Turkestan and N. America. The moth is fond of hiding in out-houses. On *Salix* and hawthorn.

Rusina tenebrosa, *Bdv.* "The Brown Feathered Rustic."

Abundant throughout B. Isles, W. and C. Europe. On *Viola*, *Rumex* and *Polygonum*.

Luperina testacea, *Hüb.* (*guenei*, Dbld.) "The Flounced Rustic."

Common generally in B. Isles (not W. Scotland), and C. Europe. Subject to extreme variations in the Gardens, the melanic form prevailing. On roots and lower stems of grasses.

GEOMETRIDAE.

This is another extensive group which is commoner in the old world than the new, and is also found in Australia but not New Zealand. The peculiar mode of progression assumed by the larvae when walking, consisting of a series of loops, owing to the middle legs being absent, has given the group the name as above. They are therefore generally easily identified when found. This does not apply to the imagines. In many cases, as in that of the genus of small moths termed the *Eupithecia*, identification is often most difficult. In a great number of instances the color of the moths is a clear green, which is comparatively rare in the *Heterocera*, but is here so constant as to be almost of systematic value. As will be seen the *Geometridae* is extremely well represented in the Gardens, and no doubt further additions will be made to this important and highly interesting group.

Boarmidae.

Cabera pusaria, *L.* (*rotundaria*, Haw.) "The Common White Wave."

A very common geometer abounding throughout British Isles, N. Europe and N. Asia. On hazel, birch, &c.

Cabera exanthemaria, *Sc.* "The Dingy White Wave."

Common to British Isles, with a wide range across Europe and Asia. On sallow, alder, birch and other deciduous trees.

Aspilates citraria, *Hüb.* (*ochrearia*, Staud.) "The Yellow Belle."

An interesting capture, the moth probably never having been recorded in Surrey previously. It was taken by Mr. G. Nicholson on the wing in the sunshine. It obtains locally in the S. and S.W. counties, S. Wales; also S. Europe, Asia Minor and N. Africa. On *Crepis taraxifolia*, *Daucus Carota*, *Plantago Coronopus* and various low plants.

Selenia illunaria, *Hüb.* (*bilunaria*, Esp.). "The Early Thorn."

Found throughout the British Isles, Europe and Asia. On blackthorn, hawthorn, dogwood, bramble, honeysuckle, &c.

Hybernia progemmaria, *Hüb.* (*marginaria*, Bkh.). "The Dotted Border."

Taken by Mr. G. Nicholson, March, 1907. The wings of the female have the appearance of being aborted, the hind wings being longer than the forewings. One of our earliest geometers. Generally occurring throughout Gt. Britain and Ireland and C. Europe. On hornbeam, whitethorn, blackthorn, hazel, oak and many other trees.

Hybernia rupicapraria, *Schiff.* "The Early Moth."

Two of the curious short-winged little females taken in March, both extremely dark. British Isles generally, C. Europe and Asia Minor. On hawthorn and blackthorn.

Biston prodromaria, *Schiff* (*stratarius*, Hüb). "The Oak Beauty."

Never very abundant, but occurring generally in England and C. Europe. A very dark one taken by H. M. Simmons on April 1st at rest on the trunk of an oak tree. On birch, oak, elm, lime, maple, blackthorn, &c.

Biston betularia, *L.* "The Peppered Moth."

Several larvae taken by W. Dallimore feeding on elm. The imago is never plentiful but occurs generally throughout the British Isles, with an extensive range in Europe, Siberia, and C. Asia. On birch, oak, sallow and many other trees.

Boarmia rhomboidaria, *Hüb.* (*gemmaria*, Brh.; *perfumaria*, Newm.). "The Willow Beauty."

British Isles generally, very common in the southern English counties. Also all over Europe, mountainous regions of C. Asia and Japan. Subject to great variation, those taken in the gardens were of the pronounced melanic variety, sometimes referred to as var. *perfumaria*. On privet, ivy, elder, lilac, hawthorn, rose, honeysuckle, clematis, jasmine, laurel, snowberry, vine, broom, and many other plants.

Anisopteryx aescularia, *Schiff.* "The March Moth."

Both the male and completely apterous female taken. The female moth strews hairs from the anal tuft over her eggs which are laid with almost geometrical precision. Common throughout England, Wales and Ireland, scarcer in Scotland ; also C. Europe. On oak, beech, hornbeam, ash, &c.

Lomaspilis marginata, *L.* "The Clouded Border."

Extremely plentiful in Q.C. grounds and very variable in its markings. Common to British Isles and the temperate regions of the northern hemisphere. On *Salix Caprea.*

ACIDALIIDAE.

Acidalia scutulata, *Schiff.* (*dimidiata*, Hufn.). "The Single Dotted Wave."

Common throughout British Isles (unfrequent in Scotland) ; also C. Europe, Madeira, W.C. Asia and W. Persia. On *Galium*, *Pimpinella*, *Anthriscus.*

Acidalia visetata, *Hufn.* "The Small Fan-footed Wave."

Common to British Isles, C. Europe, W. and N. Asia. On *Taraxacum* and *Cardamine.*

Acidalia dilutaria, *Hub.* (*interjectaria*, Bdv. ; *osseata*, Stn.) "The Dark Cream Wave."

Local in S. of England only to York. Also C. Europe, Corsica and N. Asia. On *Taraxacum* and *Anagallis.*

Acidalia remutaria, *Hüb.* "The Cream Wave."

Common to British Isles and N. and C. Europe, On *Galium*, *Asperula*, birch, sallow, knotgrass and dock.

Acidalia straminata, *Tr.* (*marginepunctata*, Stn.) "The Dotted-border Cream Wave."

Generally distributed in the home counties ; a rare local variety occurring in Lancashire and Cheshire known as *A. circellata* ; also C. Europe, Finland, Dalmatia, and W.C. Asia to Turkestan. The wild food plant is not known. In captivity the larva will feed on bramble and knot-grass.

Acidalia aversata, *L.* "The Ribbon Wave."

Extreme variation characterized those taken, from the light form without the postmedian band to a dark variety with a very dark ribbon and the discal dot apparently absent. Extremely plentiful in Q.C. Abundant where it occurs in England, local in Scotland, scarce in Ireland ; also Europe and Asia Minor. On *Cerastium*, *Galium*, *Ononis*, *Rumex*, *Lysimachia*, *Geum*, *Myosotis* and many other plants.

Acidalia virgularia, *Stn.* (*incanaria*, Hüb). "The Small Dusty Wave."

Very common in England, scarcer in Scotland, questionable in Ireland : also C. Europe, Asia Minor, Morocco and Algeria. On dandelion, knotgrass and withered leaves.

Bradyepetes amataria, *L.* (*amata*, L.). "The Blood Vein."

One specimen of this beautiful moth taken by Mr. Nicholson. Common in England and S. Ireland, local in Aberdeenshire. Throughout temperate zone of the N. hemisphere to Japan. On dock, chickweed, sorrel, and low-growing plants.

GEOMETRIDAE.

Pseudoterpna cytisaria, *Schiff.* (*pruniata*, Hufn.). "The Grass Emerald."

Generally found on heaths and open woodlands where its food plants abound. One captured in Q.C. grounds by J. B. Nicholson. General in the S. of England, Midlands, Ireland (common), and scarce in Scotland; also C. and S.E. Europe. On *Cytisus*, *Ulex*, *Genista*.

Iodis vernaria, *L.* "The Small Emerald."

Abundant in the S. and E. counties of England; throughout Europe and N. Asia. On *Clematis Vitalba*.

Iodis lactearia, *L.* "The Little Emerald."

Common throughout British Isles and temperate regions of northern hemisphere. When freshly emerged the moth has a beautiful greenish-blue metallic appearance. On birch, oak, &c.

LARENTIDAE.

Melanthia ocellata, *L.* "The Purple-bar Carpet."

Found generally throughout British Isles, Europe, and W. Asia On *Galium verum*, *G. Mollugo*, and other species of bedstraw.

Melanthia albicillata, *L.* "The Beautiful Carpet."

Plentiful in Q.C. grounds. Those caught had the ground colour in the forewings silky-white and the basal blotch blue-black. In England and Ireland generally, S. Scotland, Europe, Tartary, C. Asia, and Japan. On raspberry, bramble, and wild strawberry.

Melanthia rubiginata, *Fb.* (*bicolorata*, Hufn.). "The Blue-bordered Carpet."

This pretty little moth was found to be abundant all over the Gardens. Throughout British Isles, Europe, and Asia to Japan. On alder, blackthorn, &c.

Coremia fluctuata, *L.* "The Garden Carpet."

One of our commonest geometers. British Isles, Europe, C. Asia, N. Africa, and N. America. On *Brassica*, *Raphanus*, hedge garlic, and other cruciferous plants.

Coremia propugnata, *Schiff.* (*designata*, Rott.). "The Flame Carpet."

Common to British Isles and N. and C. Europe, N. Asia, N. America, to Arctic circle. On *Cruciferae*.

Emmelesia. An interesting genus, principally found in temperate regions of both hemispheres. The larvae feed mainly on seeds within the capsules of herbaceous plants.

Emmelesia decolorata, *Hüb.* "The Sandy Carpet."

A local species fairly plentiful in suitable spots, rare in Scotland and Ireland. Found throughout Europe, C. Asia, and N. Africa. On *Lychnis alba* and *L. diurna*. The late Mr. C. Barrett says it feeds within the calyx upon the stamens of the male flower, or piercing the capsule and devouring the unripe seeds in the case of the female flower. As it grows it hides in the partially emptied capsule. When young it eats out the contents of the unopened flower-bud.

Cidaria russata, *Schiff.* (*truncata*, Hufn.). "The Marbled Carpet."

An extremely variable species. Those obtained in the Garden were of pronounced melanic form with the dark copper colour patch in the central portion of the forewings and which have at various times been termed var. *saturata* and var. *perfuscata*. The number of intermediate forms, however, render these names useless. It is found generally throughout the British Isles and widely distributed through N. and C. Europe, Asia to Japan, and N. America from Labrador to California. On *Fragaria*, *Polygonum*, *Geranium*, sallow, birch, elm, &c.

Cidaria dotata, *L.* (*associata*, Bkh.). "The Spinach."

This species appears to be confined to gardens and their immediate neighbourhood. Not plentiful, but generally occurring throughout England ; also C. Europe, Finland, and C. Asia. On *Ribes rubrum* and *R. nigrum*.

Pelurga comitata, *L.* "The Dark Spinach."

Sparsely distributed in British Isles ; also C. and N. Europe, E. Siberia, and C. Asia. On *Atriplex* and *Chenopodium*.

Scotosia rhamnata, *Schiff.* "The Dark Umber."

A local insect usually found in chalk districts, occurring in the southern and midland counties ; also C. Europe, Asia Minor, and Japan. On *Rhamnus cathartica*.

Phibalapteryx lignata, *Hb.* (*vittata*, Bkh.). "The Oblique Carpet."

A rather local insect generally distributed throughout British Isles and N. and C. Europe. On *Galium saxatile*, *G. palustre*, and other bedstraws.

Thera variata, *Schiff.* (*obeliscata*, Hüb.). "The Shaded Broad Bar."

Extremely plentiful wherever fir trees exist. Abundant in the British Isles and temperate zones of N. hemisphere to Corea and Japan. On *Pinus sylvestris* and *Abies pectinata*.

Ypsipetes elutata, *Hüb.* (*sorditata*, F.). "The July Highflyer."

Very common throughout British Isles, N. and C. Europe, N. Asia, Japan and N. America. On *Salix*, hawthorn, &c.

Cheimatobia brumata, *L.* "The Winter Moth."

Female semi-apterous. Abundant in British Isles and N. and C. Europe. At times a great pest to the orchards, the larva

attacking the buds and later stripping the trees of leaves. Gardeners find a layer of cart grease applied to the tree-trunks effective in stopping the female, which is unable to fly, from ascending the trees. It feeds on most deciduous trees.

Oporabia dilutata, *Bkh.* (*autumnaria*, Gn.) "The November Moth."

General (often in great abundance) throughout the British Isles, N. and C. Europe, W. and N. Asia and N. America. On oak, birch, blackthorn, &c.

Chesias spartiata, *Fab.* "The Streak."

Common to British Isles and W. C. Europe. On *Cytisus scoparius*, the dried open seed pods of which the imago curiously resembles. Only extremely black specimens observed. Taken by Mr. Dallimore.

Eupithecia, Curt.—A large genus of small moths, the larvae of which usually feed on flowers, seed vessels, or seeds. The moths are practically cosmopolitan, and the large number and great similarity of those found in these islands often render their determination somewhat difficult. They are vulgarly known as "pugs."

Eupithecia centaureata, *F.* (*oblongata*, Thb.). "The Lime-speck Pug."

A very common species in the South of England and Ireland, scarcer in Scotland; also Europe and W. Asia, and common on the rock of Gibraltar. On flowers and seeds of many *Umbelliferae*, *Compositae*, &c.

Eupithecia succenturiata, *L.* "The Bordered Lime-speck Pug."

Habitat much the same as *E. centaureata*. The larvae feed on the upper surface of leaves of *Artemisia vulgaris* and occasionally on *A. maritima* and *Achillea*.

Eupithecia vulgata, *Haw.* "The Common Pug."

The commonest member of the genus being abundant throughout Great Britain and C. and S. Europe. On *Rubus*, *Senecio*, and many low-growing plants.

Eupithecia minutata, *Hub.* "The Wormwood Pug."

Fairly distributed throughout British Isles, and abroad in Holland and Germany only. On flowers of *Erica*, *Calluna* and *Scabiosa*.

Eupithecia punilata, *Hb.*

A common little moth flying about the furze bushes in the hot sunshine of July and August, and found in most of our English counties, also Scotland and Ireland. On flowers of *Ulex*, *Cytisus*, *Erica*, &c.

Eupithecia scabiosata, *Bkh.* (*subumbrata*, Gn.). "The Shaded Pug."

A local insect found in the South of England, N. and W. Ireland and C. Europe and W. C. Asia. On flowers of *Scabiosa*, *Centaurea*, *Gentiana*, &c.

Eupithecia assimilata, *Gn.* "The Currant Pug."

Common to England and S. Scotland. On *Ribes* and *Humulus.*

Eupithecia sobrinata, *Hb.* "The Juniper Pug."

Common to British Isles, N. and C. Europe. On *Juniperus.*

PYRALIDINA.

This is another large group of insects, the moths of which are remarkable for their delicate build and long spiny legs. The genera are much broken up geographically, some appearing only in S. America, others apparently confined to Australia, and many not occurring in Europe at all.

PYRAUSTIDAE.

An extremely large family; to be found all over the world, principally in the tropics.

Pyrausta ostrinalis, *Hüb.* (*purpuralis*, L.).

Common to British Isles, Europe, and Asia Minor. On *Mentha arvensis*, *Thymus vulgare*, *T. Serpyllum*, *Calamintha Acinos.*

Botys ferrugalis, *Hb.*

One dark specimen taken in October by Mrs. Hemsley. Uncertain in its appearance; possibly some years an immigrant in large numbers. Found generally throughout the British Isles and all over the globe with the exception of Australasia. On *Stachys*, *Eupatorium*, *Fragaria.*

Pionea stramentalis, *Hüb.* (*straminalis*, Hüb.). "The Chequered Straw."

Three specimens captured near the lake. A local species found only in damp woods in the southern portion of England; also C. Europe and N. America. On *Cardamine*, *Barbarea*, *Brassica* and other cruciferae.

Pionea prunalis, *Schiff.*

A moth common throughout the British Isles; C. Europe. On *Urtica*, *Teucrium*, *Stachys*, &c.

Spilodes verticalis, *Schiff.* (*ruralis*, Sc.). "The Pearl Moth."

Extremely abundant all over the Gardens wherever the nettle abounds. Also plentiful in England, scarce in Scotland and Ireland and generally throughout Europe and Asia to Japan. On the spun leaves of the stinging nettle.

Nomophila noctuella, *Schiff.* (*hybridalis*, Hüb.). "The Rush Veneer."

The only member of the genus which is found generally distributed throughout the British Isles and all over the world. On clover, grass, knotgrass, &c.

Pyralidae.

Pyralis glaucinalis, *L.* "The Double Striped."

Found locally in England as far north as Yorkshire, also temperate and sub-tropical portions of the northern hemisphere. On decayed leaves on inside twigs of birch, dead raspberry leaves, and decayed thatch.

Aglossa pinguinalis, *L.* "The Tabby."

Abundant in the British Isles, except the islands on the West Coast of Scotland, also Europe, and Asia to China, and S. Africa. Generally found in stables and outhouses. Mr. W. Buckler took great trouble to discover the actual food plants, and found that the larva confined itself to corn débris, ground corn, waste grass seeds, and dried vegetable refuse.

Aethia tarsipennalis, *Tr.*

Common in England, S. Scotland, W. Ireland, C. Europe, and N. Asia. On *Salix*, *Rubus*, *Polygonum*, &c.

Aethia grisealis, *Hüb.*

Extremely plentiful in Q.C. Common in England, N. and E. Ireland, C. Europe, and N. Asia. On *Quercus*, *Sisymbrium*.

Hypena rostralis, *L.* "The Buttoned Snout."

Locally distributed through England and Scotland, N. and C. Europe, and N. and W. Asia. On *Humulus*.

Hyphena proboscidalis, *L.* "The Snout."

Common to British Isles and temperate portions of the northern hemisphere. Extremely abundant by the lake and in Q.C. On *Urticae*.

Hydrocampidae.

Of all the *Lepidoptera* this family is perhaps the most extraordinary so far as their methods of life are concerned. The moths fly and enjoy the air as much as any others, and cannot be distinguished from those whose caterpillars live on dry land. Their breathing apparatus is like that of other moths, and they have the habits of the other night moths. But the larvae live in the water and respire in two manners. In some species of the family the larvae live in the water surrounded by a globule of air, and others positively have gills, and are surrounded and bathed by water. This is a most extraordinary fact, for the imagines which are produced by metamorphosis from these larvae resemble each other to a great extent, and it tends to show how slight the distinction may be between aquatic and air-breathing animals, and how nearly the origin of the separate conditions may be allied. The larva first mines leaves ; the pupa is generally found in a cocoon amongst leaves under water. Principally a European family.

Cataclysta lemnalis, *Schiff.* (*lemnata*, L.).

Generally distributed over England and Ireland, scarce in Scotland ; also C. and S. Europe. Larva in portable oval case of leaf fragments of *Lemna* and *Hydrocharis Morsus-ranae*.

Hydrocampa nymphaelis, *Schiff.* (*nymphaeata*, L.). "The Brown China Mark."

Common throughout British Isles, Europe and Asia Minor. Larva lives in a case composed of portions of its food plants, and floating at or near the surface of the water. On *Potamogeton*, *Sparganium*, *Myosotis palustris*, *Hydrocharis*, *Alisma*, *Nymphaea*, and other aquatic plants.

Hydrocampa stagnalis, *Gn.* (*stagnata*, Don.).

Much scarcer than the previous species. Local throughout England, Ireland and parts of Scotland; also S. Europe and Asia Minor, Siberia and Tartary. On *Sparganium*, *Nuphar* and *Nymphaea*.

Hydrocampa stratiotata, *L.* "The Ringed China Mark."

Common to England and Ireland, not Scotland; also C. Europe. The larva feeds in a web amongst leaves of *Potamogeton*, *Elodea*, *Ceratophyllum*, &c., and continually undulates the body rapidly for about twenty seconds at intervals of one to three minutes, a movement connected with respiration. (Meyrick.)

Endotrichidae.

Endotricha flammealis, *Schiff.* "The Rosy Flounced."

Local in South of England; also Finland, C. and S. Europe and Asia Minor and N. Africa. The only member of the genus to reach Europe. On fallen leaves of hazel, *Salix*, *Lotus*, &c.

Scopariidae.

Scoparia, *Haw.* A large genus mostly found in temperate regions and mountains of sub-tropical countries. The larvae usually feed on lichens and moss, forming galleries, although one species (*S. cembrae*) is known to feed on roots. Obscurely marked and difficult to distinguish.

Scoparia ambigualis, *Tr.* (*basistrigalis*, Kngs., *atomalis*, Dbdd.).

In woods in the S. and Mid. counties, also Yorkshire, Northumberland and Cumberland; C. and S. Europe, Asia Minor. On mosses growing on trees.

Scoparia mercurella, *L.* (*frequentella*, Stn.).

Common in suburbs of London and British Isles, also C. and S. Europe and N. Africa. On *Hypnum cupressiforme*, and other mosses.

Scoparia cembrae, *Hw.* (*Zelleri*, Kngs.).

British Isles generally and C. Europe. Larvae feed in a slight web on fleshy roots of *Picris hieracioides* and *Tussilago Farfara*.

Pterophoridae.

A family of curious moths. The wings are in most cases cleft, the hind wings closely folded, the bodies long and thin, and the legs unusually long and spiny. They are universally distributed,

and owing to their feathery wings are commonly known as "plume" moths. Most of the species fly at sunset, and the "white plume" (*Pterophorus pentadactylus*) must be familiar to all who take a walk in the country lanes in the cool of the summer evening. One species, *Orneodes polydactyla*, has the wings cleft into twenty-four "plumes," but this is only a "plume" in the popular sense.

Pterophorous monodactylus, *L.* (*pterodactylus*, Stn.).

Common to British Isles, also temperate portions of N. Hemisphere. On *Calystegia sepium*, *Convolvulus arvensis*. This species hibernates, and was taken at sugar in the late autumn and at ivy blossom.

Gillmeria pallidactyla, *Haw.* (*bertrami*, Rsl.).

This species has been taken, but is not common in the Gardens. The larva feeds in the shoots of *Achillea Millefolium*.

Crambidae.

A large family found principally in the temperate regions. In all the species the palpi are more or less elongated and this is characteristic of the family. The larvae usually feed in silken galleries on grasses or mosses and the imagines may sometimes be disturbed at every step when passing through fields of tall grass.

Crambus, *F.* A very large genus found all over the world, except in Australia. Seven species have so far been found in the garden.

Crambus pinellus, *L.* (*pinetellus*, L.). "The Pearl Veneer."

Two specimens of this extremely beautiful moth were taken. It occurs generally throughout the British Isles, N. and C. Europe and Asia Minor. Larva feeds among stems of grasses, *Aira*, *Eriophorum*, &c.

Crambus hortuellus, *Hüb.* "The Garden Veneer."

A very common moth found all over the British Isles, Europe, Asia, and N. America. Among stem-bases of grasses.

Crambus tristellus, *F.* "The Common Veneer."

A very common "veneer," occurring throughout British Isles, Europe, Asia Minor, and N. Asia. In silken galleries among stems of *Deschampsia flexuosa*, &c.

Chilo phragmitellus, *Hüb.*

One specimen taken by the lake. At one time it was taken freely in the Hammersmith marshes, but has long since disappeared so that it is interesting to find it still occurring in the district. Its home, however, is in the eastern counties especially in the fen district; it is also found locally in the north of England; C. and S.W. Europe, Russia, Sweden, and W. Asia to Turkestan. On *Phragmites* and *Glyceria*, in the internal lower portions of the stems. The larva often feeds below the water.

Schoenobius forficellus, *Thnb.* "The Pale Hook-tip Veneer."

Fairly common in the southern and midland counties of England, local in S. of Ireland; also C. Europe, W. Asia, N. America. In stems of *Carices*, *Phragmites communis*, *Glyceria aquatica*.

TORTRICINA.

A group of insects containing at least 350 species in the British Isles. The families and genera are closely allied and the determination of these small moths is not always an easy matter. The characteristic of the group is the costal fold, a portion of the costal margin being extended, dilated and folded back in the same way that the lapels of a coat are folded. The larvae have sixteen feet and can move quickly forwards or backwards with equal facility. The group occurs principally in the temperate portions of the globe.

TORTRICIDAE.

Tortrix podana, *Scop.* (*pyrastrana*, Hüb.). "The Great Hook-tip Tortrix."

Generally occurring throughout England, Ireland and W. Scotland, and right across the temperate zone of Europe and Asia to Japan. On hawthorn, blackthorn, oak, rose, conifers and flowers of *Azalea*. A very dark form generally found near large towns was also taken.

Tortrix costana, *Fab.* (*spectrana* Gn., *latiorana*, Wilk.). "The Straw Oblique Tortrix."

Found in England and Scotland; local in Ireland. It occurs as a rule in marshy places and fens, the specimens obtained being taken while flying over the Ha-ha. Also C. Europe and S. Russia. The moth is double-brooded and the larva feeds on the top of *Spiraea Ulmaria*, *Epilobium hirsutum*, *Potentilla palustris*, sea-lavender, sea-wormwood and most of the herbaceous plants growing in wet places.

Tortrix rosana, *L.* (*laevigana*, Gn.). "The Rose Tortrix."

Extremely plentiful in all portions of the gardens, always variable, the dark form predominating. Found throughout British Isles, Europe, Asia Minor and N. America. On deciduous trees and bushes.

Pandemis heparana, *Schiff.* "The Dark Oblique-bar Tortrix."

Throughout England, S. Scotland, local in Ireland; also temperate regions of Europe and Asia to Japan. On sallow, dewberry, birch, oak, beech, and many other trees and shrubs.

Pandemis dumetana, *Tr.* "The Thicket Tortrix."

This is an extremely local insect and hitherto has apparently been confined to Cambridgeshire, Hants, Sussex, and Kent. This would appear, therefore, to be the first record of its capture in Surrey. One specimen was taken in Q.C. grounds. It is generally found on the chalk and occurs throughout the temperate portions

of the eastern hemisphere and N. India. On *Symphytum*, *Lysimachia*, *Knautia arvensis*, *Centaurea Scabiosa*, *C. nigra*, *Malva sylvestris*, *Scrophularia aquatica*, *Mentha aquatica*, &c.

Lozotaenia unifasciana, *Dup.*

Common to S. and midland counties of England, S. Scotland, and Ireland ; S. & W. Europe, Asia Minor, and N. Africa. Food plant not actually known, but believed to be *Ligustrum vulgare.*

Heterognomon forsterana, *Fab.* (*adjunctana* Tr., Gn.). "The Forsterian Tortrix."

One of the largest of the *Tortricidae.* Local in British Isles ; generally throughout Scandinavia and N. Europe. On *Vaccinium*, *Sedum*, ivy and oak.

Dictyopteryx loeflingiana, *L.* "The Loeflingian Tortrix."

Very abundant in the gardens, and common in oak woods of the south of England. Local in Scotland and Ireland ; also C. and S. Europe and Asia Minor. On oak, hornbeam, and maple, rolling the leaves.

Dictyopteryx bergmanniana, *L.* "The Bergmannian Tortrix."

Plentiful in the gardens. Common throughout British Isles. On rose ; when young folding the leaves in the middle and living in them, later, in the shoots, drawing the leaves together.

Dictyopteryx holmiana, *L.* "The Holmian Tortrix."

Generally distributed in England, local in Scotland and Ireland ; also Europe generally (not Russia) and Asia Minor. On hawthorn, blackthorn, pear, plum, and rose, drawing the leaves together.

Dictyopteryx forskaleana, *L.* "The Forskalian Tortrix."

Moderately common in the S., E. and W. counties of England, C. Europe, Scandinavia, Italy, and Greece. On maple and sycamore in rolled leaves.

Batodes angustiorana, *Haw.* "The Red-bar Tortrix."

Common in Q.C. grounds. Locally distributed throughout British Isles, commoner in the southern English counties. Also Europe (not Russia), Asia Minor and N. Africa. On privet, yew larch, apricot, oak, and herbaceous plants.

Peronea comparana, *Hüb.* Three specimens taken at rest on poplar in Q.C. Generally in England, S. Scotland, and Ireland ; also C. Europe. On *Salix*, *Rubus*, *Potentilla palustris*, *Vaccinium Myrtillus*, and blackthorn.

Peronea variegana, *Schiff.* (*abildgaardana*, *Fröl.*). "The Rough Wing Tortrix."

Common all over the gardens but extremely variable. Generally throughout British Isles, Europe, and Asia Minor. On hawthorn, rose, bramble, apple, sloe, cherry, hazel, and elm.

Peronea asperana, *Hüb.*

Commonly found in the chalk districts of the United Kingdom ; also C. Europe, Dalmatia, Sweden, and Ireland. On *Spiraea*,

Poterium, *Rosa*, *Potentilla palustris*, *Alchemilla vulgaris*, and *Helianthemum vulgare*, folding the leaves together and feeding within.

Cnephasidae.

Sciaphila virgaureana, *Tr.* (*wahlbomiana*, L.).

Abundant throughout British Isles, C. Europe, Siberia, and Syria. On herbaceous plants, drawing the leaves together.

Sciaphila subjectana, *Gn.* (*incertana*, Tr. ?).

A very common moth, plentiful throughout British Isles; also C. Europe and Greece. On *Plantago*, *Rumex*, *Ranunculus*, *Lotus* and vetches, *Chrysanthemum* and other composites.

Sciaphila nubilana, *Hüb.*

England only, principally southern counties; also C. and S.E. Europe. In the shoots of hawthorn, blackthorn, and apple, drawing the leaves together.

Lozoperidae.

Commophila maculosana, *Haw.*

Common in Q.C. where the blue bell abounds, and general throughout England; local in Scotland and Ireland; also S. France, N. Germany, and Spain. In the seed capsules of *Scilla festalis*. When full-fed the larva bores into rotten wood, a dead oakgall, or a dry stem, swallowing the gnawings and there pupating.

Exuanthis hamana, *L.* "The Hook-mark Straw Tortrix."

Widely distributed throughout the British Isles, C. and S.-W. Europe, W.-C. Asia, and N. Persia. Larva probably feeds on roots of *Carduus*.

Sericoridae.

Poecilochroma corticana, *Schiff.*

Extremely abundant in the Gardens, on a favourable evening there being clouds of the moth in Q.C. General throughout the United Kingdom, local in Ireland; Europe. On the soft inner substance of the currant-shaped galls of the oak catkin (*Neuroterus baccarum*); also fresh soft oak-apple galls (*Biorhiza aptera*) and in rolled oak-leaves.

Trypanidae.

Trypanus cossus, *L.* (*ligniperda*, F.). "The Goat Moth."

This moth has been observed by Mr. Nicholson at various times in the Gardens, and evidence of the larvae is constantly met with when trees are felled. It is common in the British Isles, Europe, Asia, and W. Africa. The larva, which gives out a strong and unpleasant smell (hence its vulgar name), is a wood-feeder in elm, ash, poplar, and other trees, usually living two or three years in that state before it pupates.

Penthina variegana, *Hüb.* (*cynosbatella*, L. "The Rose Long-cloak Tortrix."

Distributed throughout the United Kingdom, also C. and S. Europe, Scandinavia, Russia, Finland, Asia Minor, and Armenia. On hawthorn, blackthorn, cherry, plum, apple, mountain ash, bird cherry, sweet gale, birch, alder, sallow, and ash, drawing the leaves together.

Hedya dealbana, *Fröl.* (*incarnana*, Haw.) "The White Short-cloak Tortrix."

Common in the southern and eastern counties of England, local in the Midlands, scarce in Scotland and Ireland; also C. and N. Europe, Italy, and California. On sallow, hawthorn, aspen, oak, and hazel, and in the spring on the young shoots. The larva hibernates on the twig under shelter of young buds.

Spilonota rosaecolana, *Dbd.*

Moderately common throughout England, one specimen observed in Scotland in the Botanical Gardens at Glasgow; also C. Europe, Jutland, and Trans-Caspian region. On *Rosa*, especially the cultivated varieties.

Aspis uddmanniana, *L.* "The Udmannian Tortrix."

Three taken at rest on poplar in Q.C. Generally distributed throughout England; local in Scotland and Ireland. On bramble and raspberry, drawing the leaves together.

Epiblema tripunctana, *F.* "The Black-cloaked."

Common in the British Isles, C. and S. Europe, W. Asia, and Persia. On rose, bramble, &c.

Pammene argyrana, *Hüb.* (*vernana*, Kngs.).

A very common moth abundant throughout the United Kingdom; also C. Europe. Larvae in oakgalls and fruits of apple.

Retina buoliana, *Schiff.* "The Silver-striped Orange Spot."

One specimen of this brilliant little insect captured. Moderately common in the S. and E. counties of England; also Europe and Asia to Korea. The larva hibernates, feeding in the autumn on the young buds of *Pinus sylvestris*, and in the spring on the young shoots of the same tree.

Sericoris rivulana, *Scop.* (*conchana*, Hüb.).

Plentiful locally in the S. of England, scarce in the north, Scotland and Ireland; also Europe and Asia to Siberia. It was found in Oregon, N. America, by Lord Walsingham. On *Spiraea Filipendula*, *Genista tinctoria*, *Orchis maculata*, boring into the soft stem, causing the flowers to droop and feeding among them.

Sericoris cespitana, *Hüb.*

A lively little moth found generally on the sand hills of the coast and chalk downs. Abundant in the South and Eastern counties of England, locally plentiful in some districts of Scotland and Ireland; also Europe generally, Asia Minor and Armenia. The wild food plant has not been discovered.

Sericoris lacunana, *Schiff.*

Very plentiful throughout the United Kingdom; also Europe and Western China. In the young shoots of almost all kinds of herbaceous plants and shrubs. It is sometimes double-brooded.

Steganoptycha nigromaculana, *Haw.*

Generally distributed through S. and W. counties, scarce in the Midlands, Scotland and Ireland; also C. Europe and Croatia. In the flower and seed heads of *Senecio Jacobaea*, *S. nemorensis* and allied plants. The larvae hibernate, pupating without further feeding.

Lithographia nisella, *Cl.*

Never plentiful, but widely distributed throughout the British Isles; also C. and S. Europe and Spain. In the catkins of sallow.

Halonota pflugiana, *Haw.* (*scutulana*, Schiff.).

A large tortrix, plentiful all over the Gardens. Found generally in wild and damp country throughout the British Isles; also C. and S. Europe. The larva feeds from the Autumn till May on *Cnicus palustris*, *C. lanceolatus*, *Carduus nutans* and other plants; feeding first on the leaves and flower heads, later in the stem, where it passes the winter.

Carpocapsa pomonella, *L.*

The well-known "codlin" moth. At times very destructive in orchards. It is cosmopolitan, indeed is to be found wherever the apple is grown. The larva eats a hole through the apple to get at the pips on which it feeds. As it passes from apple to apple, eating the pips only, it has been found that if the fruit is examined, and the apples that have been bored on *one* side only are picked off, a good deal of the crop may be saved.

Carpocapsa splendana, *Hüb.*

A local insect in the south of England and a few western counties; also C. Europe and Madeira. On acorns, and sometimes walnuts and Spanish chestnuts.

STIGMONOTIDAE.

Semasia woeberiana, *Schiff.* "The Woeberian Tortrix."
This common but beautifully marked little moth is abundant in the Gardens. It is to be found throughout the United Kingdom, very scarce in Ireland; also Europe and Asia to Siberia. Larva feeds on the inner bark of fruit trees, the excrement being pushed outside through a small hole.

Gypsonoma aceriana, *Dup.*

Larva in shoot of poplar in Q. Occurs locally in England; also in Europe.

Grapholitha ulicetana, *Haw.* (*succedana*, Fröl.).

Extremely abundant in the Gardens, little clouds of the moth hovering in the sunshine over the furze. Found throughout the

United Kingdom, also C. and S. Europe, Iceland, Asia Minor and N.E. Africa. Lord Walsingham also found it in Oregon, N.A. In pods of *Ulex*, *Genista*, *Lotus*, &c.

Dischrorampha alpinana, *Tr.* (*politana*, Gn.).

Local in the southern English counties (plentiful where found), scarce in the midlands and north; very scarce in Scotland and Ireland; also C. and S. Europe and Asia Minor. Lord Walsingham found it in Oregon, N.A. In the root stocks of *Achillea Millefolium*.

Dischrorampha plumbagana, *Tr.*

Common in the S. and N. of England, local in Scotland, coast only in Ireland; Europe and Asia Minor. In the stems of *Achillea Millefolium* and *Chrysanthemum Leucanthemum*.

Lipoptycha plumbana, *Scop.* (*ulicana*, Stn.).

Abundant in England, scarce in Scotland and Ireland; also C. and S. Europe, N. America and California. In the roots of *Chrysanthemum Leucanthemum*.

TINEINA.

This probably is the largest and most ancient group in the order, but owing to the small sizes of the species (at times almost microscopical), has not received the attention from entomologists which has been bestowed on the larger moths. There are probably nearly 750 moths in this group in the British Isles alone, but in a very large number of instances the life history of the insect is but little known owing to many of the species being so closely allied, the distinction between the genera so subtle and the imagines in many cases being unicolor, the classification is rendered exceedingly difficult. Many of the moths can therefore only be determined by obtaining a knowledge of the food plants, methods of feeding and pupation and following the insect through its life history. The phylogeny of the group, so far as can at present be traced, would rather tend to shew that the branch from which it has come has not been discovered, or possibly the original and intermediate forms may have disappeared ages ago.

Gelechiadae.

A very extensive family, practically cosmopolitan, not being so plentiful however in Australasia.

Tachytilia populella, *Cl.*

Plentiful in the S. and Mid. counties of England and S. Ireland. On *Salix*, poplar and birch.

Gelechia nigra, *Haw.* (*cautella*, Zell.).

A local insect occurring in the S. and Mid. counties and Northumberland; also C. Europe. On *Populus alba* and *P. Tremula*.

Gelechia ericetella, *Hüb.*

Very common throughout the British Isles, Europe, and Asia Minor. Among spun shoots of *Erica* and *Calluna*. Extremely dark forms captured.

Gelechia fugitivella, *Z.*

Fairly common throughout England, C. and S. Europe. On elm.

Ypsolophus semicostellus, *Hüb.* (*paranthesella*, Haw.). "The White Shouldered Moth."

Local in S. and Mid. counties of England; E. and C. Europe. Food plant unknown.

Symmoca quadripuncta, *Haw.*

Never abundant, occurring in the E., S., and S.W. of England, E. Ireland, C. and S. Europe, W.C. Asia to Persia. Food plant uncertain.

Aphanaula nanella, *Hüb.*

South of England from Essex to Gloucester, local; also C. Europe. One specimen taken by W. Dallimore. The larva mines in leaves of fruit trees in autumn, and in the buds in spring, after hybernation. Especially fond of the Apricot.

Oecophoridae.

A family distributed all over the world, but especially numerous in Australia, nearly a thousand species being known already from that region. The larvae nearly all feed among spun leaves on seeds or in decayed wood, rarely mining in leaves.

Carcina quercana, *F.*

A common moth to be found all over England and Ireland; C. Europe. It feeds in a web on the underside of leaves of oak, beech, apple, &c. It has been found in the gardens on *Arbutus Unedo* and *Viburnum Tinus*.

Chimbache fagella, *F.*

A little moth found all over the gardens in the early spring at rest on the trunks of trees. It is subject to great variation, extremely light and dark forms being taken from the same tree, the dark form predominating. It is distributed throughout the British Isles and C. Europe. On leaves of beech, oak, birch, &c., between joined leaves.

Depressaria, *Haw.* A large genus found throughout the temperate regions of the northern hemisphere. The larvae feed on rolled or spun leaves of *Umbelliferae*, or *Compositae*, and many of the species hibernate in the imago state.

Depressaria arenella, *Schiff.*

Very common throughout the British Isles, C. and S.-E. Europe. On *Centaurea*, *Carduus*, and *Arctium*, in the folded leaves.

Depressaria subpropinquella, *Stn.* (*rhodochrella*, Hs.).

Found generally throughont the British Isles, C. and S. Europe and Asia Minor. Larvae feed in a web beneath leaves of *Carduus* and *Centaurea*.

Depressaria applana, *F.*

Extremely abundant all over the British Isles, N. and C. Europe, and N. America. In the rolled leaves of *Anthriscus*, *Heracleum*, *Angelica*.

Oecophora sulphurella, *F.*

A pretty little moth common all over the British Isles, C. and S. Europe, and Asia Minor. The larvae feed in decayed wood.

Acompsia pseudospretella, *Stn.*

Common throughout the British Isles and practically cosmopolitan. The moth is very fond of hiding in houses, barns, and outbuildings. Larvae on seeds, skins, &c. Often destructive.

ELACHISTIDAE.

Coleophora, *Hüb.* A large genus of extremely small moths, a great similarity existing among all the species. Their determination is difficult without a knowledge of the food plants and the habits of the larvae. The markings on the wings are frequently absent or very faint. Immediately the larva is hatched it starts to mine, afterwards making and inhabiting a portable case. This it adjusts to its food and bores into the interior. Mr. Alfred Sich, F.E.S., has given this genus particular study, and has kindly imparted much information and named most of those species taken. Much remains to be done in the way of collecting these minute moths. They are rarely taken on the wing, the larvae or pupae having to be hunted for in the likely localities. There is no doubt that a large number of species will be found to occur in the Gardens.

Coleophora laricella, *Hüb.*

Several larvae taken in their cases by Mr. Sich attached to larch twigs. It seems to be very abundant in the Gardens, and is common throughout the British Isles and C. Europe. It has recently been found to occur at Ottawa in Canada. It is supposed that this species was introduced to Britain with the larch. Found on all the cultivated species of Larix.

Coleophora fuscedinella, *Zell.*

Several cases on elm in P.

Coleophora lutipenella, *Zell.*

Larval cases found by Mr. Sich on *Quercus Cerris* and *Q. pedunculata* in Q. Common in England, C. Europe, and Asia Minor. On oak and birch.

Coleophora nigricella, *Stph.*

Cases on Hawthorn in Q. Found by Mr. Sich.

Coleophora hemerobiella, *Scop.*

Cases on Hawthorn in Q. Found by Mr. Sich.

Coleophora viminetella, *Zell.*

Larva, in case, feeding on *Salix viridis* in A. Found by Mr. Sich.

Coleophora saturatella, *Stn.* (*tinctoriella*, Coverdale).

A few cases taken on broom by Mr. Sich. This is a local insect, and Meyrick says that it only occurs from Sussex to Norfolk and Denbigh. On *Cytisus* and *Genista.*

Coleophora argentula, *Zell.*

Fairly common in the southern and midland counties; also C. Europe. Cases found by Mr. Sich on seed-head of *Achillea Millefolium.*

Elachista rufocinerea, *Haw.*

Common to British Isles (except N. Scotland). In the leaves of *Poa trivialis*, *P. annua*, &c.

Chrysoclista linneella, *Cl.*

A rare insect hitherto found only in Kent, Middlesex, Gloucester, and N. Ireland ; also C. Europe and Asia Minor. Larvae feed in bark of *Tilia*. Occasionally the moths swarm on Limes around London.

Mompha fulvescens, *Hüb.* (*epilobiella*, Schrk.).

Plentiful throughout England, E. Ireland, and C. Europe. On spun shoots of *Epilobium hirsutum*.

Scythris chenopodiella, *Hüb.*

A local insect found hitherto only in Middlesex, Essex, Gloucester, and York ; also Europe, W.-C. Asia, and N. Persia. Among flowers and shoots of *Chenopodium* and *Atriplex*.

Endrosis lacteella, *Schiff.* (*fenestrella*, Stn.).

One of the so-called "clothes" moths. At times very destructive. Found a great deal in houses, feeding on seeds, dry refuse, &c. It is cosmopolitan.

PLUTELLIDAE.

This family is not largely represented in Britain, and appears to be more at home in Australasia. The larvae feed generally in a slight web on leaves and seeds.

Yponomeuta vigintipunctatus, *Retz.*

Mr. G. Nicholson took a small colony of caterpillars in September, 1906, feeding on the heads of *Sedum Telephium*, its usual food plant. When full fed they spun up in a thick web and emerged in the first week of April, 1907. It is a rather scarce insect, being local in Kent to Dorset and Norfolk ; also C. Europe.

Yponomeuta padellus, *L.*

One of the commonest of the genus. Plentiful in Q. Found throughout England and Ireland ; also Europe and W.C. Asia to Turkestan. On blackthorn, hawthorn and apple.

Glyphipteryx fuscoviridella, *Haw.*

A common moth in England and S. Europe. The larva was discovered by Mr. Sich feeding in stems of *Luzula campestris*.

Cerostoma radiatella, *Don.*

Extremely abundant throughout the British Isles. On oak.

Plutella maculipennis, *L.* "The Diamond-back Moth."

This insect is in some years very plentiful and a great nuisance to the farmer. Last year, 1906, in most southern English counties especially Essex, the larva became a pest, attacking the root crops. It was also recorded as being abundant in the neighbourhood of Aberdeen.

TINEIDAE.

A very large family of small moths, some species being almost microscopical. Although the genera are closely allied the forms at times are greatly at variance. Outside Europe the study of this

portion of the *micro-lepidoptera* has received attention in a perfunctory manner only, so that the habitat of the various species is but indifferently known. The family is probably cosmopolitan.

Lithocolletis, *Hüb.* A large and difficult genus to determine. It occurs principally in the northern hemisphere, one species only being known to occur in Australia. The larvae mine in leaves making a small patch on one side of the leaf only, either the upper or underside.

Lithocolletis concomitella, *Bnks.*

The distribution of this species is little known, as it was only separated by Mr. Bankes in 1899. The larva mines the leaves of apple; underside. Dissected by Mr. Sich.

Lithocolletis oxyacanthae, *Frey.*

Separated by Mr. Bankes and Dr. Wood in 1899. Probably common in Q. One off hawthorn (dissected by Mr. Sich).

Lithocolletis faginella, *Zell.* (*triguttella*, Stn.).

Abundant throughout the British Isles and C. Europe. In leaves of beech; underside.

Lithocolletis quercifoliella, *Zell.*

A common species throughout Europe. Mines leaves of oak; underside.

Lithocolletis messaniella, *Zell.*

Bred from *mines* taken on an evergreen oak by Mr. Sich. Plentiful in England, S. Scotland, N. and E. Ireland, C. Europe and Asia Minor. In leaves of *Quercus Ilex*; underside. The mines are abundant in the Gardens.

Lithocolletis cramerella, *Zell.*

Very common throughout the British Isles, N. and C. Europe, Asia Minor. In leaves of oak; underside.

Lithocolletis carpinicolella, *Stn.*

Local in the S.E. of England and Norfolk; C. Europe. In leaves of hornbeam; upperside.

Lithocolletis corylifoliella, *Haw.*

A common species. The larva mines the leaves of hawthorn, apple, &c.; upperside.

Lithocolletis tristrigella, *Haw.*

Rather local. Mines in elm leaves, underside, in July and September.

Ornix anglicella, *Stn.* (*fragariae*, Stn.).

Taken on the wing by Mr. G. Nicholson and Mr. Sich along the hawthorn hedge in Q. Very common in England and N. Ireland. Within conically-folded leaves of hawthorn and *Fragaria*.

Ornix scoticella, *Stn.*

A northern species. One imago on bark of *Pyrus pinnatifida*.

Gracilaria syringella, *F.*

Abundant throughout the British Isles; Europe generally. In rolled leaves of ash, *Syringa* and *Ligustrum*.

Leucoptera spartifoliella, *Hüb.*

Common to the British Isles and C. Europe. Larvae in the stems of *Cytisus scoparius*.

Bucculatrix, *Zell.* A genus remarkable on account of the absence of palpi in the imago, and of the curious ribbed cocoon spun by the larva.

Bucculatrix ulmella, *Zell.*

The larva feeds on oak in this country, but is attached to elm on the Continent. Possibly the oak-feeder is a distinct species; if so, Stainton's name, *sircomella*, will have to be restored. Taken by Mr. G. Nicholson in Q., where the cocoons are not rare on oak trunks.

Nepticula, *Zell.* A large genus containing the smallest British moths. The larvae feed on the parenchyma between the cuticles of leaves. Many species doubtless occur in the Gardens.

Nepticula gratiosella, *Stn.*

This species measures considerably less than a quarter-of-an-inch from tip to tip of the wings. The colours are golden-brown and violet. The larva feeds up to maturity in a single lobe of a hawthorn leaf. Taken by Mr. G. Nicholson on hawthorn in Q.C.

Argyresthia, *Hüb.* An interesting genus of little moths. In repose all the species sit with the back part of the body raised from the surface so that they appear to be standing on their heads. The larvae pupate in a thick white cocoon.

Argyresthia nitidella, *F.* (*purpurascentella*, Stn.).

Abundant thoroughout British Isles, also C. Europe. Larva in shoots of hawthorn.

Argyresthia ephippella, *Fab.*

Common in England and N. Ireland; also C. Europe and Asia Minor. In shoots of *Prunus Cerasus*.

Incurvaria muscalella, *F.* (*masculella*, Hüb.).

Common in England, S. Scotland, and N. and E. Ireland; Europe. On hawthorn, *Ribes*.

Tineola biselliella, *Hüm.*

A local insect occurring in England, S. Scotland, E. Ireland; also Europe, N. Africa, N. America, Australia, and New Zealand. Artificially spread by human agency. In hair, wool, and dry substances.

Tinea, *L.* A very large genus found all over the world. Many of the species are minute, and the larvae feed on many and various foods, from lichen and fungi to dead wood and cloth.

Tinea granella, *L.*

Found generally in granaries; common all over the world, spreading artificially. On corn grains.

Tinea cloacella, *Haw.* (*ruricolella*, Stn.).

Abundant in British Isles; generally throughout temperate regions of the northern hemisphere. In fungi and dead wood. Plentiful in Q.

Tinea lapella, *Hüb.* (*ganomella*, Tr.).

Fairly plentiful in England and E. Ireland; also C. Europe and Asia Minor. Larvae in nest of birds.

Tinea semifulvella, *Haw.*

Common in England and S. Scotland; C. Europe. Larvae in nest of birds.

Nemophora swammerdammella, *L.*

Abundant in United Kingdom and E. Ireland; C. Europe, W.-C. Asia, and N. Persia. Larvae in cases of leaf fragments, low plants, and fallen leaves.

Nemophora schwarziella, *Z.*

Generally distributed throughout the United Kingdom, N. and E. Ireland; C. Europe. Food plant not known.

Adela, *Latr.* A genus of brilliant little moths with metallic colourings. The antennae are in some species from four to five times as long as the body. The larvae feed in flowers and in flat cases on leaves, and the imagines fly in the hottest sunshine during the early summer months. They are particularly plentiful in the Gardens.

Adela viridella, *Sc.*

Common all over England, especially where there are oak underwoods; also Europe and Asia Minor. On the leaves of oak and hawthorn.

Adela degeerella, *L.*

All over England and S. Ireland; Europe and Asia Minor. On leaf fragments, in flat cases, of many low plants and fallen leaves.

Adela cuprella, *Thnb.*

A scarce insect found in a few localities only in England, Scotland, and E. Ireland; also N. and C. Europe. On flowers of *Salix Caprea*.

MICROPTERYGINA.

Hepialidae.

The moths belonging to this family have been deposed from the high position they once occupied. Formerly it was the custom to place them almost immediately following the *Sphingidae*, but a closer study has relegated them to the opposite end of the order. They are no doubt among the most ancient existing forms of *Lepidoptera*, and are apparently an offshoot from the *Micropterygidae*, and mark a line of evolution quite distinct from other groups. The moths are not small, some exotic species measuring six inches across the wings. They are cosmopolitan.

Hepialus sylvinus, *L.*—"The Orange Swift."

Moderately common throughout the British Isles; also N. and C. Europe and Asia Minor. The specimen taken by Mrs. Dallimore. On roots of *Rumex*, *Taraxacum*, &c.

Eriocraniidae.

These are curious, brilliantly coloured little moths which delight to fly on warm afternoons in early spring. As yet only one species has been taken in the Gardens, but others are certain to occur.

Eriocrania unimaculella, *Zett.*

Taken by Mr. G. Nicholson off birch trees. The footless larva mines in leaves of birch.

XXXII.—AFRICAN TREE RUBBER.

(*Funtumia elastica*, Stapf.)

The *Funtum* or *Ire*, one of the most important sources of West African rubber, was definitely determined and fully described in the *Kew Bulletin* for 1905, pp. 56–58, by Dr. O. Stapf. The economic information regarding the tree and its products has been given in the *Bulletin* for 1895, pp. 241–247; for 1896, pp. 76, 77; for 1897, pp. 414, 415; for 1899, pp. 29–35. More recently it has been ascertained that the species is not confined to West African forests, but that it occurs in the forests of Uganda, where it is now also being planted. As recently explained (*K.B.* for 1907, No. 3, pp. 103–105) this rubber has been introduced from West Africa and distributed from Kew to the East and the West Indies. The information regarding this species contained in the notes reproduced below is therefore of general interest.

Tapping Funtumia Rubber.

In a letter addressed to the editor of the *Agricultural News*, Barbados, which appeared in that journal, vol. vi., No. 127, p. 77, Mr. H. Hesketh Bell, C.M.G., supplies an interesting account of the system of tapping indigenous *Funtumia elastica* trees in Uganda, and of the subsequent treatment of the latex and preparation of the product for the market:—

Government House,
Entebbe, Uganda,
January 3, 1907.

"I have just been reading in the Bulletin of the Imperial Department of Agriculture a very interesting account by Mr. Joseph Jones of the experimental tapping of various kinds of rubber trees in the Dominica Botanic Station, and I note that he is rather troubled by the dark colour of the produce, more especially that yielded by the Funtumia trees. In view of the great interest that is now being taken in the cultivation of rubber in the West Indies, it may be useful to some of your readers to know how the latex of rubber is treated in Uganda.

"In some of the great forests of this territory, considerable numbers of trees of the *Funtumia elastica*, or 'Lagos Silk Rubber' are found, and concessions for the sole right of tapping these trees are held by various companies. While visiting the Budonga Forest lately, I had an opportunity of observing the manner in which the crude latex is treated. The milk is obtained by making small 'herring-bone' incisions in one side of the trunks of the trees. These incisions are made with a V-shaped tapping tool, and reach from the base of the tree up to a height of 40 or 50 feet. Funtumia, growing in a forest in its natural condition, has a slender straight stem of great height, and branches only at the top. The trees are tapped every three months, so that, in each year, every side of the trunk has been made to yield its milk. The average yield of latex, at each tapping, is about 1 quart from each tree, and each stem may be expected to give about 1 lb. of pure rubber per annum.

"The milk is brought at once to the factory and is allowed to stand for a couple of days in large earthenware pots. It is then strained through pieces of red cotton, known as 'Turkey red,' for the removal of impurities. An equal quantity of water is added to the latex, and about a pint of the mixture is placed at a time in a small earthenware vessel. This small pot is then placed in a larger vessel containing water maintained at a temperature just below boiling point, after the fashion of a 'bain-marie.' Carbonate of potash is added in the proportion of 1 per cent. to the latex and water, and the mixture is stirred with a wooden spoon until it coagulates. This usually occurs after three or four minutes. In the factory which I inspected there was a rough and ready 'range' of six small fires, so that half a dozen lots of latex could be dealt with simultaneously. Each pot, however, required the attention of one man. The carbonate of potash appears to prevent the rubber from turning to a dark colour. As soon as the latex has coagulated, the 'dollop' of rubber is taken out of the pot and placed under a press, so that all the moisture may be extracted from it. The press is very much like the sort used for taking copies of letters in offices, and being supplied with four or five boards can deal with several cakes of rubber at a time. The one I saw was worked by two men, and the pressure exerted was so great that each clot of rubber was quickly transformed into a very thin 'pancake' of creamy-white colour, each bearing the initials or brand of the company. This process very effectually extracts not only all the water but also nearly all the resin in the rubber. The pancakes, after passing through the press, are thoroughly washed in water and placed to dry in the shade, on shelves made of reeds. The rubber gradually assumes a dark amber colour, but it is almost perfectly clean and transparent. In a few days it is fit for transport. I have much pleasure in sending you a sample of the rubber thus prepared, and would ask you, after inspection to send it to the Curator of the Botanic Station at Dominica.

"A considerable quantity of Funtumia has been planted in the West Indies during the last two or three years and these notes may be of interest to the planters there. I may add that the produce of the Funtumia, obtained by the process above described, is now selling in London at 5*s.* 6*d.* per lb., a price almost equalling

that obtained for the best Para. It has heretofore been thought that Funtumia rubber could not compare in value with the product of Para or of Castilloa."

Funtumia Rubber in Ceylon.

From the Report for 1906 of the Government Entomologist, Ceylon (vol. iii., No. 22, December, 1906), it is to be gathered that the experimental cultivation of *Funtumia elastica* in that island has proved unsuccessful owing to the injury caused by a leaf-rolling caterpillar, *Caprinia conchydalis*, Green. The report is as follows :—

"The pests of the various rubber-producing trees have naturally attracted considerable attention, but with the exception of a leaf-rolling caterpillar that defoliates 'Kickxia rubber' (*Funtumia elastica*), no really serious insect pests have yet asserted themselves in Ceylon.

"We cannot, however, rely upon any long-continued immunity. With the great extension of rubber plantations now in progress, fresh pests are sure to appear. It will behove rubber planters to keep a careful watch for any signs of attack. If taken in time most insect pests can be checked. Fortunately, latex-bearing trees—while in good health—are self-protected from bark and wood-boring insects. This protection is lost when, from any cause, the supply of latex is reduced. Root diseases have so far proved the most fertile source of such debility, and are almost invariably followed by the invasion of 'white ants' (Termites) and boring beetles of various kinds. These insects are generally wrongly credited with the death of such fungus-infected plants. Any attempt to penetrate the latex-bearing tissues of a healthy rubber plant must inevitably result in the defeat and probable death of the invader. The period of latex-reduction that follows systematic tapping will be a time of danger, and artificial means of protection may be necessary at such times. Careless tapping, resulting in injury to the cambium, will render the trees particularly susceptible to attack. 'Ceara rubber' trees, under tapping, appear to be exceptionally liable to disease, and many fatalities from this cause have been recorded.

"The cultivation of 'Kickxia rubber' is rendered impracticable in Ceylon owing to the systematic assaults of a leaf-rolling caterpillar (*Caprinia conchydalis*, Green). Defoliation commences even in the nursery and is continued during the growth of the plant, at more or less regular periods of three months, when the young trees are denuded of every single leaf. Under such circumstances it is impossible for the plants to make good growth, and it is surprising that they even continue to exist. The pest can be checked by repeated spraying with arsenical compounds ; but on a large clearing this would be quite impracticable, or at least would render the cultivation of this species of rubber unprofitable in comparison with the hardier *Hevea*."

Funtumia Rubber in the East Africa Protectorate.

The subjoined information is extracted from *Colonial Report*, No. 519, East Africa Protectorate, for 1905-6, p. 80, regarding the Government Experimental Station at Meritini (Mazeras).

Lagos Rubber (*Funtumia elastica*).—A consignment of seed of this tree was received from the Botanic Station at Lagos. It germinated well, and the young plants have grown very freely. Nineteen were permanently planted out in November of the year under review.

The same species of rubber tree has recently been discovered in Uganda, and a parcel of seed has been received from the Department of Agriculture and Forestry there. This seed also germinated freely, and the plants are healthy. Upwards of 2,000 *Funtumia* plants will be available for planting during the next rainy season. It is intended to plant out several acres of this tree near the station. If the *Funtumia* should succeed there, as would soon be seen, large areas could be dealt with.

XXXIII.—MUD-BINDING GRASSES.

(*Spartina stricta*, Linn., and allied forms.)

The question of sea-defence work, now occupying the attention of the Royal Commission on Coast Erosion, is one of great general interest. Much has been recorded with regard to mechanical devices for arresting the removal and promoting the accretion of shingle, while the preservation and fixation of dunes by sand-binding grasses and other sand-loving plants has been dealt with so often that the subject now possesses a voluminous literature of its own. This literature has been fully summarised by Gerhardt in *Handbuch des deutschen Dünenbaues*,* pp. 629–644, Berlin, 1900, to which reference may be made by those who may desire full information on the subject.

The latest and one of the most comprehensive accounts of sand-binding grasses enumerated by Gerhardt is that by Mr. Lamson-Scribner, published in the *Year Book of the United States Department of Agriculture for 1898*, pp. 405–420. A perusal of this paper may be recommended to all who desire to find the salient facts clearly presented in a concise manner.

As compared with the effects of vegetation in preserving sandy shores and fixing sandy foreshores, the action of plants in assisting the accretion of mud and in fixing and preserving muddy foreshores has received comparatively little systematic attention. A sketch of these processes as they present themselves in the great Gangetic delta has been given in the *Records of the Botanical Survey of India*, vol. ii., No. 4, pp. 231 *et seq.*,† and incidental allusions to the subject are to be found scattered throughout the literature of topographical and geological botany. The subject is, however, one that is of much interest everywhere from the purely scientific point of view, and one that even in this country may be of considerable practical importance.

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* Handbuch des deutschen Dünenbaues im Auftrage des Kgl. Preuss. Ministerium der öffentlichen Arbeiten und unter Mitwirkung von Dr. Johannes Abromeit, Paul Bock, Dr. Alfred Jentzsch, herausgegeben von Paul Gerhardt; Berlin, 1900, pp. i.–xxviii., 1–656, with 445 figures in the text.

† See especially a reference to the action of *Oryza coarctata*, Roxb., at p. 357.

Giving evidence recently before the Royal Commission on Coast Erosion, Lord Montagu of Beaulieu is reported as follows: "The mud-banks on his property had recently been increasing very rapidly. The accretion was due to a somewhat extraordinary fact. Some years ago a ship came up Southampton Water from the River Plate with a quantity of rice-grass on board. The seeds of this grass became distributed about the shores of Southampton Water, with the result that the whole of that estuary was now covered with this grass. It was a plant which grew very rapidly and spread in circles, and now the 20 miles from Hurst Castle to Southampton were covered with this grass, as were the mud-banks on his foreshore. The stiff and sharp points caught the seaweed which came over it, causing the bank to increase rapidly in height . . . . There was no knowledge of the grass, so far as he could understand, up to 10 years ago."

To anyone knowing the vegetation of the coast of Southampton Water, it was evident that the grass in question must be a member of the genus *Spartina*, though the names "rice-grass" and "sea-rice" are unknown in botanical literature, and unknown, we believe, to those most versed in the popular names of British plants.

Supplementary to his evidence before the Commission, Lord Montagu sent to Kew some old culms and some living clumps of the grass, with a view to its identification and for any particulars that could be given of its history and origin.

The fact that some botanists now recognise three distinct species of *Spartina* in the British Flora, whilst others regard the three recognisable English Spartinas as varieties, or sometimes only as forms hardly entitled to rank as varieties of one species, rendered it necessary to reply in some detail, though it is by no means unlikely that the local names cover the three, whatever status be given them. The subject is perhaps of sufficient importance for us to put on record here the substance of the reply made to Lord Montagu and other inquirers, together with some additional particulars of a more technical character.

Whether the three forms of *Spartina* be regarded as distinct species or as only varieties or forms of one species, is of minor importance. But from the practical standpoint it is well, if they can be distinguished at all, to indicate clearly how they differ because of the possible possession by one or the other of the "species," as they will for the sake of convenience be here termed, of greater vegetative vigour than the rest, thus rendering a particular form of more importance than the others, so far as mud-binding is concerned.

The alleged distinctive characters of the three species, all of which grow in Southampton Water, are extracted from the ninth edition of Babington's "Manual of British Botany" (1904), edited by H. and J. Groves, who have made a special study of the genus *Spartina*, as represented in the United Kingdom.

1. *S. stricta*, Roth; leaves jointed to their sheaths, falling short of the spikes; spikelets 2 or 3; rachis scarcely extending beyond the last spikelet, outer glume hairy. Stem 1–2 feet high. Leaves

narrowing to the base, where they easily separate from their sheaths. Spikes pressed close together. A remarkably rigid plant.

2. *S. Townsendi*, Groves ; leaves jointed to their sheaths, falling short of the spikes ; spikelets 4–9 ; rachis produced beyond the spikelets and flexuose ; outer glumes slightly downy. Stem 1½–4 feet high. Leaves broadest at base. Spikelets rather spreading.

3. *S. alterniflora*, Loisel. ; leaves continuous with their sheaths, equalling or exceeding the 6–8 spikes ; spikelets many ; rachis produced beyond the spikelets and flexuose ; outer glume glabrous. Stem 2–3 feet high. Leaves broadest at the base. Spikes loosely pressed together.

Accompanying the specimens sent by Lord Montagu was the following memorandum :—

"MEMORANDUM on a certain reed locally called 'Rice-grass' or 'Sea-rice' growing in Southampton Water, Beaulieu River, and on the mud-flats from Hurst Castle eastwards along the Hampshire Coast.

"This grass, which was only to be found in a small patch in Southampton Water till a few years ago, has now extended over a very great area which might be estimated between 6,000 and 8,000 acres. It flowers in the early summer, and its seeds are apparently a great favourite with birds, while cattle, rabbits, &c., also feed on it through the summer and autumn. It spreads with remarkable rapidity, and the young plants take a circular form, so it apparently grows outwards from the common root. I am sending herewith some specimens for examination at the request of the Chairman of the Royal Commission on Coast Erosion, Mr. Ivor Guest, M.P. The Commission desire to know the exact name of the plant, its origin, and what is known about it. Locally it is supposed to have come accidentally from the River Plate in a grain ship."

So far as may be judged from the plants sent by Lord Montagu, the grass to which reference is made in his evidence and memorandum is the one to which the name of *Spartina alterniflora* has been applied, and not the typical *Spartina stricta*, though definite determination must await the flowering of the plants sent ; these are being cultivated at Kew with this object.

On the authority of Townsend ("Flora of Hampshire," ed. 1, 1883, p. 400), the first record of *Spartina stricta* occurring in Hampshire is by Dean Garnier in "The Annual Hampshire Repository" for 1799. From this earliest record up to 1836, all the *Spartina* collected in Southampton Water was regarded as *S. stricta*, but in that year Dr. W. Arnold Bromfield, the talented author of the "Flora Vectensis," published in Hooker's "*Companion to the Botanical Magazine*," vol. i., pp. 254–263, a detailed account of what he regarded as a different species, which he identified at first with *S. glabra*, Muhlenb., and subsequently with *S. alterniflora*, Loisel. Dr. Bromfield devoted a great deal of time to the investigation of this plant, as distinguished from *S. stricta*, and he has put on record that it then occupied different areas, the two never intermingling, though patches of the two

grew side by side. He found *S. alterniflora* only on the Itchen, and the following details of the conditions under which it grew, and the uses to which it was put at that date, are of considerable interest :—

"The proportion in quantity between *S. alterniflora* and *S. stricta* at Southampton is very unequal, the predominance in favour of the new species being, on the most moderate estimate, at least ten to one. *S. alterniflora* seems, as far as I can ascertain, to be the only kind above the Itchen Ferry, where it occurs in vast profusion, in irregular patches or fields of very various dimensions, from a dozen yards to two or three hundred in circumference, thickly scattered over the great beds of mud and ooze, partly covered, and partly above the surface at high water, the treacherous and shifting soil of which, our plant, amongst its other valuable qualities, contributes, with its densely fibrous and matted roots and runners, materially to consolidate. These Spartina-swamps extend along each side of the river, beginning just above the village of Itchen, to within a few hundred yards of Northam Bridge, beyond which I have never met with either kind. Our *Spartina* adds to the richness of the view from Pear-tree Green, and other elevated spots, by the mellow tint of its masses that clothe the shores ; the culm and leaves acquiring, in incipient decay, at this season (Oct. 23rd), a fine reddish-brown or tawny hue, totally unlike the pale, dull, ashy colour which *S. stricta* puts on late in the year. Below the ferry and descending towards the junction of the Itchen and Southampton rivers, *S. alterniflora* reappears in smaller quantity and of less luxuriant growth ; and here, for the first time, *stricta* begins to show itself in detached portions, often growing side by side with the former, but never mingling with it.

"The people employed about the ferry are unanimous in asserting that *S. alterniflora* was not found below that point till of late years, it being a tradition among them that the plant was brought from some place higher up the stream on the first melting of the ice after a hard winter, about twelve or fourteen years back, as far as I can collect, though of the precise date no one pretends to speak positively. Nor do any of them profess to know how long it has been growing above the ferry, though all agree it is much more abundant there now than ever, and is still increasing annually. One old man declared to me, he remembered it all his life on the upper station ; another that there was none of it in his younger days. It is difficult to reconcile such conflicting accounts, except by supposing different plants to be confounded together—*Scirpus maritimus*, perhaps, which is plentiful along the shore, yet far less so than our *Spartina*. I have traced its termination upwards, which finishes below Northam Bridge. Much higher it could not occur, as the Itchen soon loses the character of a tide-river, and at Wood Mills, not above three or four miles from its junction with the Southampton estuary, becomes a freshwater stream.

"It is possible our Southampton *alterniflora* may have been imported from America, either in ballast, or as a packing material in stowing the hold, and so have become naturalized with us. Its prodigious quantity is against the supposition ; and, indeed, we are

only justified in suspecting its exotic origin from the account just given (one not very conclusive of the inference), and from the fact, that as far as we know, this species of *Spartina* has not before been detected elsewhere in this or any other European country.

"The poorer classes of Southampton employ *Spartina alterniflora* for thatching the roofs of out-houses, cattle-sheds, &c., in lieu of reeds; more extensively for litter, and subsequently for manure. Horses are stated to eat it greedily, and for all these purposes it is regularly mown at the end of September, at which time large quantities may be seen lying on the shore to dry, previous to carting. Hardly a single accessible patch, either on the upper or lower station, is suffered to remain uncut, so that it is a plant of real economical utility. I cannot learn that it is known amongst the inhabitants by any other name than that of Sedge."

It will be understood from the foregoing that Bromfield suspected that the plant was a colonist, and in a later article (*Phytologist*, 1850, vol. iii., p. 1095–1908), he says :—"Although unable to ascertain with any precision the date of its introduction to this country, I cannot persuade myself that this fine grass is aboriginal in this county. My objections to receive it as a strictly indigenous grass are, first, its limitation in Europe to a couple of stations on the western coasts, both sea-ports having constant communication with America, where it is very abundant. Secondly, the weight of local evidence goes to prove that the many-spiked cord-grass was unknown at Southampton within the memory of persons now living, and although the evidence I have been able to collect be sufficiently confused and contradictory to show that very little is known about the origin of this grass with certainty, it is not so weak that we can safely set it aside in a case so open to suspicion as the one before us."

In 1850 Bromfield still only knew of the Itchen station in Southampton Water, and in the eighth edition of Babington's "Manual," 1881, no other locality is given, though others may have been on record elsewhere. But from the first edition of Townsend's "Flora," 1883, we learn that it was then abundant from Hythe to Eling, on the Hamble and at Hill Head.

The following summary of the distribution of *Spartina* in Hampshire is extracted from Townsend's "Flora of Hampshire," 2nd edition, 1904, p. 479; the wider distribution is derived from various authorities.

S. stricta: shore at Exbury in plenty; along the Yare, near the shore at Norton, Yarmouth, Newtown, &c. (Isle of Wight) abundantly; Hythe; banks of Southampton river, plentiful; Itchen ferry; Southton; about Portsmouth, abundant; Hayling Island; coast near Warblington church.

Distribution in the United Kingdom.—Devon, Hampshire, Sussex, Kent, Essex, Suffolk, Norfolk, and Lincoln.

Distribution beyond the United Kingdom.—Coast of Europe, from Holland to Gibraltar, and in the Adriatic; South Africa; North America, common on the Atlantic coast, rare on the Pacific.

S. Townsendi: near Lymington; between Milford and Hurst castle; near Yarmouth and west side of Medina river at Werrar, (Isle of Wight); abundant south of Hythe, less plentiful northward, and not noticed above Crocknore Hard; Havant to Emsworth; Hayling Island.

DISTRIBUTION IN THE UNITED KINGDOM.—Dorset, Hampshire, Sussex, and Kent.

DISTRIBUTION BEYOND THE UNITED KINGDOM.—No station recorded, but Husnot ("Graminees," p. 13), with Southampton specimens before him treats *S. Townsendi* as a variety of *S. stricta.*

S. alterniflora: Lymington; Hythe to Eling, abundant; Redbridge to Millbrook, plentiful; by the Itchen, from the sea upwards to beyond Southton, profusely; Hamble and Hill Head; about the mouths of Shirley brook; coast road from Southton to Netley.

DISTRIBUTION IN THE UNITED KINGDOM.—No record of it having been found outside of the Southampton district.

DISTRIBUTION BEYOND THE UNITED KINGDOM.—Banks of the Adour, Bayonne, and at Fuenterrabia, just over the Spanish boundary; North America.

Figures of the three species are given in the publications cited below:—

S. stricta: Eng. Bot. ed. 1, 1797, vol. vi., t. 380—specimen from Aldborough; ed. 2, 1832, vol. i., t. 190; ed. 3, 1872, vol. xi., t. 1687; Reichenb. Ic. Fl. Germ., 1834, vol. i., t. 25; Sowerby, Grasses of Great Britain, 1861, t. 140.

S. Townsendi: Journ. Bot. 1882, t. 225.

S. alterniflora: Baxter, Brit. Bot. 1836, vol. iii., t. 203 (*S. stricta* on plate); Eng. Bot., ed. 1, Suppl. 1838, vol. iii., 2812; ed. 3, 1872, vol. xi., t. 1688; Sowerby, Grasses of Great Britain, 1861, t. 141; Pratt, Fl. Pl. Great Britain, vol. vi., t. 272, f. 4.

In connection with the discovery of *S. alterniflora*, it may be mentioned that there is a specimen in Borrer's Herbarium, at Kew, collected by him at Southampton in July, 1829, seven years before Bromfield's discovery. It was at first named *stricta*, and subsequently altered in his own handwriting.

S. alterniflora was described by Loiseleur (Fl. Gall., ed. 1, par. 2, p. 719) in 1807, from specimens collected on the banks of the river Adour, near Bayonne.

S. Townsendi, Groves, was first recorded, from Hythe specimens, in the "Journal of Botany," 1879, p. 277, as a variety of *S. stricta*, and subsequently described and figured as a distinct species in the "Report of the Botanical Exchange Club" for 1880-1, p. 37.

With regard to the popular name applied to this kind of grass, as stated above, Bromfield heard no other than Sedge, of which Saga or Sagg, given by Townsend under *S. alterniflora*, are probably corruptions.

As to whether *S. alterniflora* was originally introduced from America into Europe, tradition, and its very restricted distribution

in Europe, favour the hypothesis. Coste, "Flore de la France," 1906, vol. iii., p. 554, "Landes, Basses-Pyrénées," does not necessarily extend the area in France, as the Departments are bounded by the river Adour. American botanists mostly treat *S. stricta* and *S. alterniflora* as varieties of one species, and Britton and Brown, "Illustrated Flora," 1896, vol. i., p. 177, state that "our plant does not seem to have been satisfactorily identified with the European."

It may be useful to add that there is a manuscript monograph at Kew of the genus *Spartina* by J. Gay, with the inscription at the beginning: "Commencé le 29 Juillet et fini, pour la quatrième fois, le 3 Août, 1819."

In response to a letter asking whether any light could be thrown on the name "rice-grass," which has now for the first time been quoted in connection with *Spartina*, the vernacular name hitherto given being "cord-grass," Lord Montagu of Beaulieu, writes on May 2, 1907, :—"Mr. Rankin, of the Portsmouth Marine Biological Institute, who was at Beaulieu last Saturday, told me he thought the plant growing on my foreshore was *Spartina stricta*, and not the *alterniflora*. He seemed to be quite aware of the term 'rice-grass,' though I did not specifically ask him what the plant was called locally in the neighbourhood of Portsmouth, where it also abounds. Certainly round the estuary of the Beaulieu river and in the district around Lymington I have never heard it called by any other name, but I will make inquiries this week end, and find out whether there are any people who call it 'Sagg.' Personally I have never heard this word."

The day before this letter was written an interesting and valuable paper on "The protection of Seashores from Erosion" was read before the Society of Arts by Mr. A. E. Carey. In the discussion on this paper Lord Montagu of Beaulieu took part. After recapitulating the evidence already given by him before the Royal Commission on coast erosion, and referring to the report he had received from Kew, as to the identity of the grasses concerned, Lord Montagu is reported to have said, with regard to *Spartina alterniflora*, that "the first record he personally found of it was about 1833, when it was mentioned in some Hampshire records as having existed at what was then known as Itchen ferry, on what is now known as the Woolston shore of Southampton Water." This is interesting as being a record three years prior to that made by Dr. Bromfield, though it is still four years subsequent to the first known collection of the grass in the same neighbourhood by Mr. Borrer.

Continuing, Lord Montagu is reported as having said that the grass "certainly did not exist on the mudflats in the Solent until within the last ten years. He could recollect when there was none in the Beaulieu river, which was a large estuary; but it was now entirely choked up with it, although the main waterway was as open as ever it was. He could not help thinking that the grass would be a most valuable addition to the means of reclaiming mud and sand flats near the mouths of rivers. He did not know that it would act in very exposed places, but he had noticed in the

Solent, when there was a considerable sea on, and where the grass grew down to the water's edge, that when big waves came it seemed to withstand their action very much better than where the mud existed without grass."

XXXIV.—MISCELLANEOUS NOTES.

G. D. Haviland.—The Court of Probate has recently presumed the death of Dr. George Darby Haviland who had been missing since 1901.

Dr. Haviland has been a contributor to the Kew Herbarium since 1891. All his collections were made in Northern Borneo, and chiefly in Sarawak, where he acted till 1893 as medical officer to the Sarawak Government, and afterwards as curator of the Government Museum at Kuching. He returned to England in 1895, and worked for some time in the Herbarium at Kew on a revision of the *Naucleae*, which was published in the *Journal of the Linnean Society* in 1897 (Bot. vol. xxxiii., pp. 1–94, tab. 1–4), and on a monograph of the genus *Acranthera*. The latter remained, however, unfinished. Subsequently he went to South Africa for the purpose of studying the habits of the Termites a paper on which from his pen appeared in the *Journal of the Linnean Society* in 1897 (Zool. vol. xxvi., No. 169) under the title "Observations on Termites with descriptions of new species." He was so successful in this field that his mode of classification has, we understand, been adopted by the workers on the subject, while his collections of Termites are regarded as the finest ever brought to Europe. In 1901 he was staying with relations at Estcourt, Natal. One day he went out on his bicycle apparently for a trip into the hilly country around. He never returned, nor was he heard of again. His bicycle, however, was found a year afterwards near the ascent.

The collections presented to Kew by Dr. Haviland comprise about 2,500 specimens, prepared with considerable care and often under difficult conditions. When his duties as curator of the Kuching Museum claimed most of his time he employed, for collecting, Dyaks whom he had trained, and he always made it a point to mention their names on the labels. Later on his name was, on the labels, coupled with that of Dr. Charles Hose, nephew of the Bishop of Singapore and Sarawak. The first set of specimens was not numbered, but provided instead with a cumbrous system of ciphers, the first letter standing for the year of collecting (*a* for 1888, *b* for 1889, &c.), the second for the half-month (*a* for Jan. 1–15, *b* for Jan. 16–31, &c.), the third for the day of the half-month (the letters after *r* being used when the day was not quite certain), the fourth for the number of the plant collected on the day corresponding to the preceding letters. Where a fifth letter occurs it indicates that he believed the plant to be identical with one collected previously and denoted by the first four letters.

The collections proved very rich in novelties, a certain number of which have been described in the *Kew Bulletin* and in other publications. The most important contribution was, however, a

collection made by Dr. G. D. Haviland and his cousin Dr. H. A. Haviland on Kinabalu in 1892. This, together with an earlier collection by Sir Hugh Low, formed the basis of a memoir by the writer on the Flora of Mount Kinabalu (*Trans. Linn. Soc.*, ser. ii., vol. iv., pp. 69–263, tt. 11–20).

Dr. Haviland, who was born at Warbleton, Sussex, in 1857, was a man of considerable ability, but of a retiring disposition, and almost morbid modesty where his own work was concerned. He was an idealist and a great lover of nature who, with a little more self-confidence, might have achieved much as a naturalist. Under a somewhat austere outside he concealed what was really a kind-hearted and generous nature.

O. S.

Radermachera pentandra.—A young tree of this Bignoniad is now in flower in the Temperate House at Kew. It was presented by Messrs. J. Veitch & Sons in 1901, along with a set of plants raised from seeds collected by Mr. E. H. Wilson during his first visit to China. He described it as a large tree, but Dr. Henry, who first discovered the species in Mengtze, Yunnan, at 5,000 feet, says he did not see any trees of it more than 20 or 30 feet high. The genus *Radermachera* used to be included in *Stereospermum* which comprised about a dozen species, all of them trees of good size and yielding useful timber. *R. pentandra* was figured in *Hooker's Icones Plantarum*, t. 2,728 (1905), and described by Mr. Hemsley from specimens collected by Dr. Henry. The plant in the Temperate House is 16 feet high, and it has a stem 4 inches in diameter. It has a few leaves near the top, the largest being 4 feet long and 3 feet wide, 2–3-pinnate, the leaflets ovate-lanceolate, from 5 to 12 inches long, green, smooth, and leathery in texture. The flowers, which are cream-yellow, are 3 inches wide, bell-shaped and regular, and are not unlike those of *Beaumontia grandiflora*. The Kew plant has produced only a small panicle of flowers, but the wild specimens show a large many-flowered panicle. The tree should be a good addition to tropical and sub-tropical gardens; it is not likely to thrive in the open air in any part of the British Islands, and it is too large for glass houses except such as the Kew Temperate House.

W. W.

Anti-Opium Plants. *Combretum sundaicum*, Miq. (*Combretaceae*) and *Mitragyne speciosa*, Korth. (*Rubiaceae*).—Mr. J. B. Carruthers, Director of Agriculture Federated Malay States, has forwarded for the Museum from Kuala Lumpur dried specimens of the first-mentioned plant, which has recently attracted considerable attention as the "Anti-Opium Plant."

Further specimens have been received from Mr. L. Wray, I.S.O., who has discussed the subject very fully in the *Journal of the Federated Malay States Museum*, No. i., vol. ii., 1906. There is also a note by Mr. E. M. Holmes in the *Pharmaceutical Journal*, vol. 78, p. 77, and one by Mr. J. B. Carruthers in *Agricultural*

Bulletin of the Straits and Federated Malay States, No. ii., vol. vi., 1907, which deals with the matter, and in the latter volume at p. 453 is given an abstract of Mr. Wray's observations on the plant, and a communication from Mr. D. Hooper drawing attention to an article by Mr. H. N. Ridley in *Journal of the Asiatic Society* for July, 1897, wherein the writer refers to the leaves of *Mitragyne speciosa*, Korth., as being employed in Perak as a remedy for the opium habit. The leaves of an allied species (*M. parvifolia*) are employed in India as a fodder for cattle, but do not appear to be put to any other use.

Specimens of *Combretum sundaicum* have also been received at the Herbarium from Dr. T. B. Sprague of Edinburgh; these came from the Batu Caves Estate, Kuala Lumpur, and were obtained through the kind offices of Mr. Christopher Meikle, whose attention was drawn to the plant by seeing Chinamen carrying off bundles of it to be used as an anti-opium remedy. For this purpose the whole plant, except the thickest stems, is chopped up and infused.

In the Straits *Agricultural Bulletin*, No. ii., vol. vi., Mr. H. N. Ridley mentions two plants that have been referred to him as being of value in combatting the opium craving. One of these appears to be *Combretum sundaicum*; the specimens came from Kuala Lumpur. The other, which was described as a herb from China, is a species of *Gynura* (*Compositae*), Mr. Ridley has been unable to distinguish from *G. ovalis*, DC.

The specimens are exhibited in Case 52, Museum No. I.

J. M. H.

Presentations.—GARDEN. A number of living plants exhibited at the South African Products Exhibition were, at its close, presented to Kew. Among these were some fine masses of several species of *Lycopodium*, from Pietermaritzburg; *Sarcocaulon Burmanni*, the torch plant, from Cape Colony; *Ornithogalum lacteum* and *O. thyrsoides*; also several orchids. Various seeds were also presented; these included a collection of the varieties of *Zea Mays* and of *Ricinus communis*, with seeds of Acacias, of *Calodendron capense* (wild chestnut), and other trees.

MUSEUMS. At the close of the same exhibition, which was held in London between February 22nd and March 16th, 1907, large and varied collections of Vegetable Economic Products, including food-grains, tanning barks, tobacco, cotton, fruits, medicinal plants, &c., were presented to the Museums at Kew on behalf of their respective Governments by Mr. C. du Chiappini, Trades Commissioner for the Cape of Good Hope, Mr. J. Burtt Davy, Government Agrostologist and Botanist, Transvaal, and Mr. T. R. Sim, Conservator of Forests, Natal.

The Museums are further indebted to Sir D. Morris, K.C.M.G., Commissioner, Imperial Department of Agriculture, West Indies, for an excellent series of miscellaneous vegetable products, prepared by Mr. W. Robson, Curator of the Botanic Station, Montserrat,

for the Colonial Products Exhibition held at Liverpool between March 12th and 24th, 1907. At the close of the exhibition the collection was transferred to Kew.

HERBARIUM. A suite of specimens representing four species of *Fraxinus* and one of *Styrax*, from Japan, has been presented to Kew by the Hon. Vicary Gibbs. The specimens which form this valuable gift were obtained for Mr. Gibbs by Mr. R. Walter from Dr. Fukuba, of the Imperial Gardens, and Dr. Hirosawa, of the Forestry Department, Tokio.

LIBRARY. A copy of *Food for the Tropics*, a work containing short descriptions of the cereals, vegetables, root crops and fruits usually cultivated in the Tropics for domestic use, compiled by the late Mr. T. M. MacKnight, has been presented by Mrs. McKnight to the Library at Kew. Mrs. MacKnight has also generously supplied twenty additional copies of the same work for presentation to "those men who go out trained from Kew Botanic Gardens to the Tropics."

Benthamiana.—The library is indebted to Sir J. D. Hooker, G.C.S.I., C.B., for the gift of a further series of valuable manuscripts, remains of the late Mr. Bentham. These include Mr. Bentham's journals, diaries and autobiography.

Botanical Magazine for April.—The plants figured are: *Caesalpinia vernalis*, Champ., × *Odontioda heatonensis*, *Aloe campylosiphon*, A. Berger, *Primula orbicularis*, Hemsl., and *Hoodia Currori*, Decne. The *Caesalpinia* is a climbing shrub with elegant bipinnate leaves and rather long racemes of lemon-yellow flowers, bearing on the upper petal a scarlet blotch. It is known only from Hongkong, and seeds were sent to Kew in 1883 from the Botanic Gardens there. *Odontioda heatonensis* is a garden hybrid between *Odontoglossum cirrhosum* and *Cochlioda sanguinea*, Benth., having been raised by Messrs. Charlesworth & Co., Heaton, Bradford, who presented the plant figured to the Kew collection. There are now four hybrids between *Odontoglossum* and *Cochlioda*, the first to appear, *Odontioda Vuylstekeae*, is depicted at t. 7,990 of this work. *Aloe campylosiphon* has recently been introduced from German East Africa by Dr. Engler, Director of the Berlin Botanic Garden, who sent a plant to the late Sir Thomas Hanbury, in whose gardens at La Mortola it flowered in 1905, and again in 1906. The plate was prepared from material furnished by the La Mortola plant. Mr. Berger regards it as a very distinct species somewhat resembling *A. saponaria*, Haw. *Primula orbicularis* is a new introduction from Western China, where seeds were collected for Messrs. James Veitch & Sons by Mr. E. H. Wilson. The flowers are pale yellow and fragrant, and are arranged in a terminal umbel borne on a stout scape 15 inches high. The corolla-limb, and its lobes too, are orbicular in shape, whence the name. *Hoodia Currori* is an Angolan plant belonging to the *Asclepiadaceae*. The

purplish-red saucer-shaped flowers are 3½–5 in. across, and are borne 2 to 4 together at the apex of the tuberculate spiny succulent stem. The specimen figured was sent to Kew by Mr. J. Gossweiler, Curator of the Botanic Gardens at Loanda. Placed in a moist stove it made active growth and flowered in June, 1906.

A Russian estimate of Kew.—Mr. V. J. Lipsky, one of the Principal Botanists of the Imperial Botanic Gardens at St. Petersburg, has twice visited Kew and made a stay of considerable duration on each occasion, and each visit has been followed by a report on various European Botanical Gardens, including Kew, published as appendices to the "Acta Horti Petropolitani." These reports are entirely in Russian, but with the help of Miss Olivia Garnett, who is acting as a Temporary Assistant in the Herbarium, we have been able to learn something of their nature and scope. Mr. Lipsky's first visit was in 1900, and in 1901 he published a report on the Botanical Establishments of Vienna, Munich, Geneva, Paris, London (Kew, British Museum, and Linnean Society), Brussels and Berlin. Some 30 pages out of 123 are devoted to Kew, dealing successively with the Herbarium, the Library, the "Park," the North Gallery, the Glass Houses and the Museums. There is an excellent reproduction of the "Key Plan" to the garden and the installation and working arrangements of the various branches of the establishment are described at length.

The second report, issued towards the end of last year, is a more detailed one, running to 267 pages, though it only deals with the Botanical Establishments of Madrid, Lisbon and Kew; 190 of those 267 pages are devoted to Kew. In 1905 Mr. Lipsky spent the greater part of six weeks at the Herbarium, examining the Tibetan plants collected by English travellers. His spare time was devoted to the gardens, and 127 pages of this report are occupied with the living plants, their arrangement, and the housing of the tender ones. He takes successively the collections of *Lilium*, *Iris*, *Rosa*, *Rhododendron*, *Clematis*, &c., &c., giving complete lists of the species, with remarks on their numbers, appearance and condition. The same treatment is given to the collections under glass.

Mr. Lipsky appeared particularly struck by the gardens as affording a reflection of the social life of Englishmen; his remarks are enthusiastic and complimentary. He has studied many public gardens, he says, but not only is there not one that can compare with Kew, not even all of them put together. The gardens at Kew are, he thinks, for the people who visit them in tens of thousands with perfect freedom, unhindered by officialdom, educational in the best sense. He describes the grass, explaining how it is cut and kept, and how visitors are allowed to walk or lie upon it. The report is illustrated by excellent views of the Palm House, the Temperate House and the North Gallery.

Diagrams of Plant Diseases.—The Board of Agriculture and Fisheries have issued a further series of coloured diagrams prepared under the supervision of the Director of the Royal Botanic Gardens, Kew, to accompany the first series, which deals with diseases of forest trees. The second series deals with diseases of fruit and fruit-bearing plants. These diagrams, which are suitable for lecture rooms, museums, schools, &c., are contained in seven sheets, 21 in. by 15 in., price 1*s.* each sheet, or 6*s.* 6*d.* a set. They will be sent post free on receipt of the money with the order. Remittances should take the form of cheques or postal orders, and not stamps. Each diagram is accompanied by a brief account of the disease, together with a statement of the measures to be taken for their prevention or eradication, printed in large type, in the form of a wall sheet. A small hand-book giving similar information can also be had, price 1*d.* The following diseases are included in the diagrams :—

No. 1. Strawberry leaf-spot, Strawberry mildew, Apple-rot, Cherry scab.

No. 2. Apple mildew, Apple canker, heart-wood rot, tree-root rot.

No. 3. Bladder Plums, Peach leaf-curl, shot-hole fungus, leaf blight.

No. 4. Apple scab, Pear scab, brown rot.

No. 5. Vine leaf-blotch, Vine leaf-scorch, black rot of Vine, powdery mildew of Vine.

No. 6. Pear leaf cluster-cups, Apricot rust, American Gooseberry disease.

No. 7. Walnut leaf-blotch, Cherry leaf-scorch, Hazel mildew, silver leaf.

The diagrams in the first series, dealing with forest trees, referred to above, are as follows :—

No. 1. Coral-spot disease, Plane leaf-scorch, Apple-tree canker, golden tree-agaric.

No. 2. Pine trametes, Apple heart-wood rot, scaly tree-polyporus, common hairy stereum, false tinder fungus.

No. 3. Conifer cluster-cups.

No. 4. Collar rot, Birch polyporus, Conifer root-rot, tinder fungus, slimy tree-agaric.

No. 5. Heart-wood rot, Birch polyporus, dry rot, wet wood-rot.

No. 6. Peach leaf-curl, Apple-tree mildew, Pear leaf cluster-cups, Sycamore leaf-blotch.

No. 7. Larch canker, conifer rust.

No. 8. "Witches' Brooms" of Silver fir.

No. 9. Conifer seedling blight, Spruce canker, Pine branch twist, seedling mildew, Osier rust.

These diagrams can be obtained at the office of the Board of Agriculture and Fisheries, 4, Whitehall Place, London, S.W.